DRAFT INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

NATIONAL REGIONAL SEDIMENT MANAGEMENT (RSM) PROGRAM WRDA 2016 SECTION 1122

BENEFICIAL USE PILOT PROJECT

Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas

US Army Corps of Engineers®

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1.0 Introduction and Project Authority

The U.S. Army Corps of Engineers (USACE) Galveston District (CESWG) has prepared this Draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) for the WRDA Section 1122 Beneficial Use Pilot Project, Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas. It was prepared to be consistent with the Continuing Authorities Program (CAP) Section 204, of the Water Resources Development Act and contains information relevant to both an environmental assessment to satisfy the National Environmental Policy Act (NEPA) and a Planning and Design Analysis used as a planning document USACE. A draft Finding of No Significant Impact (FONSI) is attached to this Draft IFR/EA.

This study explores the feasibility of implementing a pilot project for the beneficial use of dredged material generated from O&M dredging of the Sabine River for marsh restoration at a degraded parcel in close proximity to the channel.

This pilot project was proposed as a partnership between CESWG, Ducks Unlimited (DU) and the Port of Orange. It is one of ten final proposals evaluated for selection from 95 submittals. The USACE Headquarters evaluation board funded ten proposals that were deemed to have a high likelihood of environmental, economic and social benefits, and exhibited geographic diversity.

Managing sediment to benefit a region potentially saves money, allows use of natural processes to solve engineering problems, and improves the environment. Regional sediment management (RSM) is a management method that considers the broader environment, and accounts for the effect of human activities on sediment erosion as well as its transport in streams, lakes, bays, and oceans. The beneficial use (BU) of dredge sediment protects and enhances the nation's natural resources while balancing national security and economic needs

This Draft IFR-EA proposes participation in the first of several possible increments of marsh restoration adjacent to the waterway. It describes the ecological and public benefits to be achieved through beneficial use of dredge material. The decision document proposes participation in one phase of the pilot project encompasses the beneficial use of material dredged from Sabine River to restore marsh habitats in an eroded parcel and support coastal resilience along the Gulf Coast.

Section 1122 of the Water Resources Development Act (WRDA) 2016 USACE to establish a pilot program to carry out 10 projects for the beneficial use of dredged material, including for the project purposes of:

- reducing storm damage to property and infrastructure;
- promoting public safety;
- protecting, restoring, and creating aquatic ecosystem habitats;
- stabilizing stream systems and enhancing shorelines;
- promoting recreation;
- supporting risk management adaptation strategies; and

- reducing the costs of dredging and dredged material placement or disposal, such as for projects that use dredged material as construction or fill material, civic improvement objectives, and other innovative uses and placement alternatives that produce public economic or environmental benefits.

Implementation Guidance for Section 1122 was signed by the Acting Assistant Secretary of the Army (ASA-CW) on January 3, 2018. Draft Guidance for Major Subordinate Commands (MSC) and District Commands was provided by the USACE Director of Civil Works in January 2019. The Guidance indicates that the Section 1122 Pilot Projects should follow the policies outlined in the USACE Planning Guidance Notebook (PGN) (ER 1105-2-100) for Section 204 of the Continuing Authorities Projects (CAP). Section 204 of the Water Resources Development Act of 1992, as amended, authorizes USACE to implement projects for the protection, restoration and creation of aquatic and ecologically related habitats, including wetlands, or to reduce storm damage to property, in connection with dredging for the construction or O&M of an existing authorized Federal navigation project.

In general, Section 1122 projects will be cost shared in accordance with Section 204 of the CAP; however, if the 204 project relies on dredged material from a federal navigation project, the transportation of the material beyond the Federal Standard will be at a 100% federal cost.

1.1. Background

The Sabine-Neches Waterway (SNWW) project is a network of deep and shallow navigation channels totaling approximately 97 miles. The project extends from the deep water of the Gulf of Mexico, through a jettied inlet, to the port facilities at Port Arthur, the Port of Beaumont (via the Neches River), and the Port of Orange (via the Sabine River). The project is located in the vicinities of Beaumont, Port Arthur, Orange, and Sabine Pass in Jefferson and Orange Counties, Texas, and Cameron and Calcasieu Parishes, Louisiana.

The Ports of Beaumont, Port Arthur, and Orange are ranked 5th, 19th, and 133rd respectively. The SNWW total commercial tonnage for 2019 was 140.1 million tons; Beaumont 100.2 million tons, Port Arthur 39.9 million tons, and Port of Orange 1.6 million tons. The Ports of Beaumont and Port Arthur are also designated as a Strategic Harbors, as military personnel, equipment and supplies are deployed and redeployed through its port facilities. SNWW is first in the U.S. with crude oil imports and supplies 55% of the Nation’s strategic petroleum reserves.
The SNWW navigation project supports a large percentage of the nation's petrochemical industry and two Liquefied Natural Gas (LNG) facilities.

SNWW from the Gulf of Mexico to Port Arthur and Port Beaumont is authorized to 40ft MLLW. The Sabine River reach, the portion of channel from the SNWW proposed to be dredged for the Section 1122 project, is authorized to 31ft MLLW.

The non-Federal Sponsor for the 40ft MLLW portion of the SNWW is the Sabine-Neches Navigation District. The non-Federal Sponsor for the Sabine River reach is the Orange County Navigation and Port District.

The Sabine River is not regularly dredged and there is no current Dredge Material Management Plan in effect.

Figure 1. SNWW Study Area Map

1.2.   Purpose and Need for the Study (NEPA Required*)

The project purpose is to beneficially use dredge material to restore critical marsh habitat. This study evaluates the appropriate design of marsh on a specifically designated parcel with material from a designated federal navigation channel. This study proposes participation in one phase of several possible marsh restoration increments with dredged material generated by future cycles of O & M dredging at Sabine-Neches Waterway. The Environmental Assessment (EA) will review the potential benefits and impacts of future restoration increments with dredge material to support continued BU if future opportunities arise.

Marshes along the Gulf Coast are receding due to many factors including interruption of freshwater inflows, erosion due to wind waves, navigation traffic, climate change and increased salinity. Erosion and increased salinity scours sediment and destabilizes sensitive vegetation that sustain stable shorelines. Continued exposure to coastal forces leaves marshes at risk of continued erosion and recession, especially in areas along navigation channels and large bodies of water.

The proposed action is to dredge approximately 21,000 linear feet of the Sabine-Neches Water Way and beneficially use the dredge material at Hickory Cove Marsh, a parcel located approximately 1,500 ft north of the Sabine River. Because interior portions of the channel are shoaled to a depth of 26 feet, it may be determined not to be beneficial to the government to dredge to the authorized depth of 31 feet plus 2 feet of overdepth. The 26 foot depth dredging would provide approximately 500,000 cubic yards of sediment, and the 31 foot depth dredging would produce approximately 1.3 mcy. All elevations herein, unless otherwise noted, are reported in MLLW vertical datum.

This study proposes participation in one phase of marsh restoration generated in future cycles of operations and maintenance dredging of the Sabine River. This approach is an innovative partnership to create ecological benefits and reduced navigation costs in a region with limited available disposal alternatives. The EA to satisfy NEPA assesses the potential benefits and impacts of a series of potential placements to facilitate further BU on the site, although there are no planned future placements at this time.

In addition to the immediate benefits that this project would provide through marsh restoration at the Hickory Cove Marsh, the pilot project also provides an opportunity to demonstrate the efficiency of beneficial use, the multiple benefits to be achieved through ecosystem restoration instead of simple placement area reliance, and to highlight institutional impediments to regular BU in the region. The effort can be a proof-of-concept to determine:

- The potential for significant benefits to natural and cultural resources.
- Whether similar placement sites could provide multiple benefit streams along federal waterways with limited or near capacity placement areas, assuming environmental compliance documentation is completed.
- The anticipated costs for Non Federal Sponsors or partners to implement this strategy for repeated dredge cycles in the future,
- Whether the implementation process and the final product are satisfactory to local municipalities.

Depending on these outcomes, the proposed pilot project has the potential to become a new tool for regional stakeholders who are hoping to expand sustainable and collaborative habitat restoration options in the region. Managing sediment to benefit a region potentially saves money, allows use of natural processes to solve engineering problems, and improves the environment. Regional sediment management (RSM) is a management method that considers the broader environment, and accounts for the effect of human activities on sediment erosion as well as its transport in streams, lakes, bays, and oceans. The BU of dredge sediment as protects and enhances the nation's natural resources while balancing national security and economic needs.

1.3. Congressional Delegation and Sponsor

a) Congressional Delegation: Rep. Babin (TX-36th)

b) **Sponsor:** Orange County Navigation and Port District, Orange, Texas will serve as the non-Federal sponsor for the Section 1122 project (hereinafter the “NFS”)

2.0 Base Plan

The authorized depth of the Sabine River proposed as the source for sediment is 31 feet. There is no placement area and routine maintenance of the Sabine River has been limited. If a placement area were available, this portion of the Sabine River would likely be dredged on a three to five year cycle based on funding allocation.

The Base Plan is the least costly plan that accomplishes the disposal of dredged material from a federal navigation project, consistent with sound engineering practices and environmental standards. The existing Base Plan for management of dredged material from the Sabine River and surrounding channels has been to place it in designated placement areas (PAs) along the shoreline.

When completing a typical Section 204 beneficial use of dredged material projects, cost increases above the Base Plan are shared at 65% federal and 35% non-federal. Under Section 1122 of WRDA 2016, incremental costs of transportation and placement of dredged material above the Base Plan are covered at 100% federal expense. Any additional measures beyond transportation and placement would be cost-shared at 65% federal and 35% non-federal.

PAs 29A/B, shown below in Figure 2, is an upland confined placement area at a parcel designated for dredge material placement from the Sabine River reach from stations 0+00 to stations 230+00. PAs 29A/B have a combined acreage of 277 acres and was considered to be the baseline/future without project (FWOP) condition for comparison to the alternative placement. In 2012, these PAs were used for an emergency dredging of a smaller amount of dredge material. The dredge pipeline distance from the borrow source to PAs 29 A/B has a 3 mile pipeline distance, which is one mile longer than the required dredge pipeline distance of 2 miles from the borrow area to Hickory Cove Marsh.

Improvements would be required to prepare PAs 29 A/B to receive dredge material from the Sabine River. The site improvements would include site preparation, construction of approximately 756,000 linear feet of dike lift and a replacement spillbox. After comparing the cost of the FWOP/Baseline condition to the Hickory Cove Marsh placement alternatives, it was determined that placement at Hickory Cove Marsh is the lowest cost alternative and designated to be the Federal Standard. The base year was considered to be 2023, the year that O&M dredging of the Sabine River is proposed for funding.

Approximately 21,000 linear feet of the Sabine River is proposed to be dredged to a depth of 26 feet. Since interior portions of the channel are shoaled to a depth of 26 feet, it was not determined to be beneficial to the government to dredge to the authorized depth of 31 feet. The 26 foot depth dredging would provide approximately 500,000 cubic yards of sediment. In subsequent years, channel infilling will be monitored and maintenance required. This pilot project will beneficially use a nearby parcel at Hickory Cove Marsh located approximately 1,500 ft north of the Sabine River.

The marsh restoration designed under the Section 1122 pilot project will demonstrate an innovative placement concept to restore marsh habitat at Hickory Cove Marsh that was lost to coastal forces over time. The action will create a future placement area to facilitate routine channel maintenance cycles into the future and demonstrate a strategy to restore or enhance coastal habitat in the region in combination with future maintenance dredging efforts.

Two sites were evaluated to confirm that Hickory Cove was a viable site for investment in ecosystem restoration in the region. Two features to enhance the sustainability of the restored marsh were formulated and evaluated to confirm ecological lift of the measure and would justify the federal investment of the incremental cost.

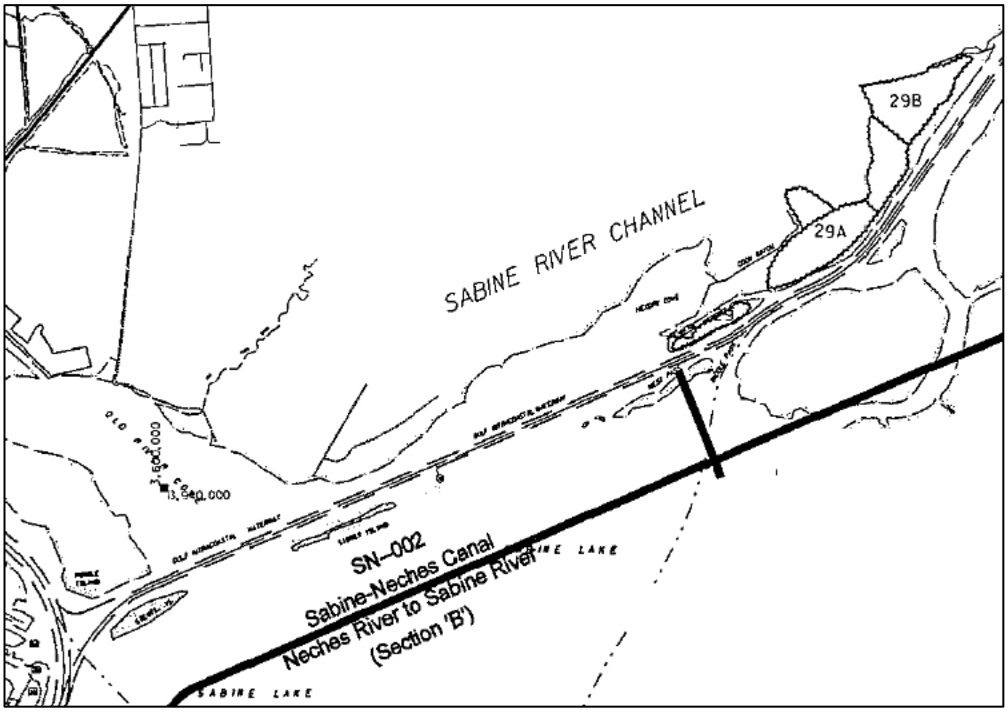

Figure 2 partial of Sabine River

3.0 Existing Condition

This chapter presents a description of the environmental resources and baseline conditions for environmental resources and other disciplines, that could be affected from implementing the proposed alternative in compliance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ), and 32 CFR 775 guidelines. The level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact.

The project is located within Hickory Cove Bay in an area known as the saddle where the Sabine and Neches rivers merge into Sabine Lake in Orange County, Texas. The project area includes 1,200 acres of marsh lands and open water areas of Sabine Lake. Sabine Lake is an estuary situated in the southeast corner of Texas along the border of Texas and Louisiana. The land is owned and operated by the Hawk Club, a private hunting club, and adjacent to the Lower Neches Wildlife Management Area (WMA) which is owned and operated by Texas Parks and Wildlife Department (TPWD). There are two federal navigation projects in or near the study area including the Sabine-Neches Waterway (SNWW) and the Gulf Intercoastal Waterway (GIWW). No major transportation roadways, railways, or airports are located in the study area and only a few access roads constructed and maintained by the landowner are found in the project area.

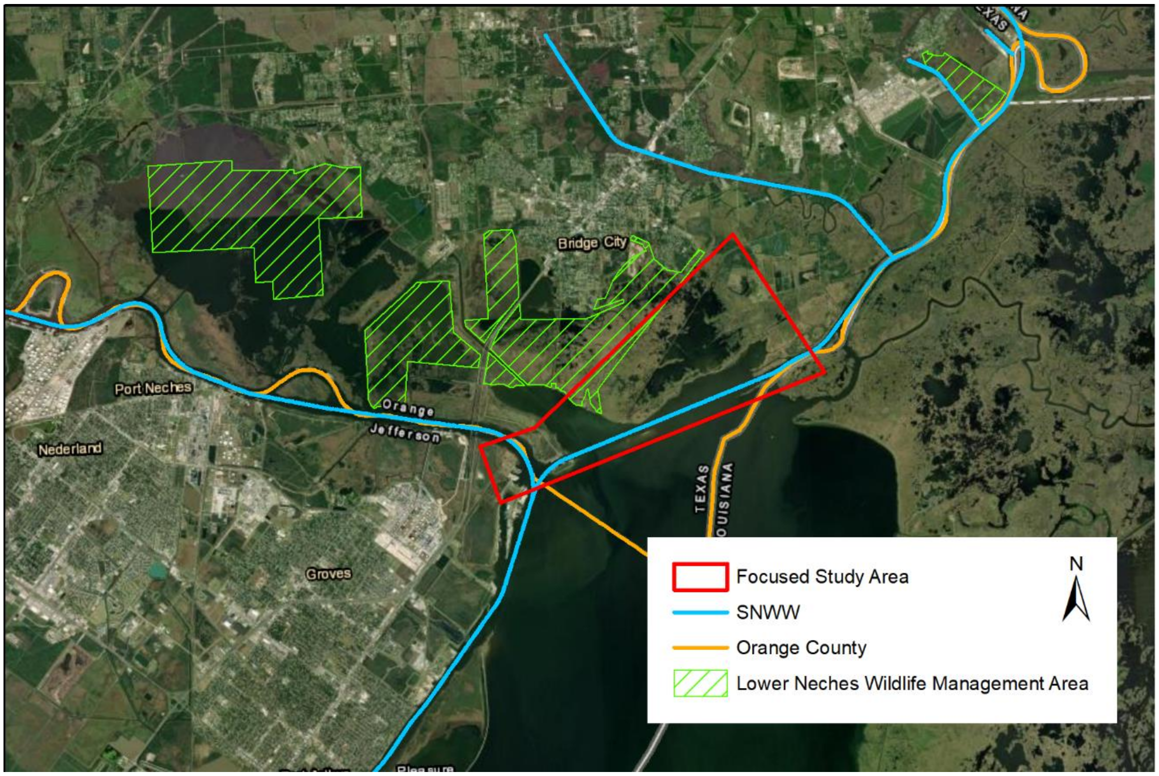

Figure 3. Feasibility Study Area

3.1. Air Quality

The Clean Air Act, as amended in 1990, authorizes the Environmental Protection Agency (EPA) to designate areas as nonattainment and to classify them according to the degree of severity. Classification, in turn, triggers a set of control requirements designed to bring areas into attainment by their specified attainment date. Orange County is in the Beaumont-Port Arthur (BPA) Air Quality Control Region (AQCR). BPA area counties are designated as Attainment-Maintenance for the 1997 Ozone Standard, Attainment/Unclassifiable for the 2008 Eight-Hour Ozone Standard of 0.075 ppm [75 ppb], and Attainment/Unclassifiable for the 2015 Eight-Hour Ozone Standard of 0.070 ppm [70 ppb].

The area was classified as serious nonattainment for the one-hour ozone NAAQS, which was revoked on June 15, 2005; however, the BPA area was not attaining the standard at the time of revocation and remained subject to continuing serious area anti-backsliding requirements. The EPA finalized a determination of attainment for the BPA area for the one-hour ozone standards in 2010 and determined that redesignation of the area to attainment for the 1997 eight-hour ozone NAAQS removed the requirement for the continued application of the one-hour anti-backsliding measures. Though the BPA was never formally redesignated to attainment for the revoked one-hour ozone NAAQS, the maintenance plan for the 1997 eight-hour ozone NAAQS effectively acted as a maintenance plan for the one-hour ozone NAAQS. In 2018, litigation challenged the EPA's final 2008 eight-hour ozone standard State Implementation Plan (SIP) requirements rule, which revoked the 1997 eight-hour ozone NAAQS. The Court's decision vacated parts of the EPA's final 2008 eight-hour ozone standard SIP requirements rule, including the removal of anti-backsliding requirements for areas designated nonattainment under the 1997 eight-hour ozone NAAQS, waiving requirements for transportation conformity for maintenance areas under the 1997 eight-hour ozone NAAQS and elimination of the requirement to submit a second 10-year maintenance plan. The EPA identified the BPA area as an orphan maintenance area as a result of the rulings, which meant that the area was initially designated nonattainment for the 1997 eight-hour ozone NAAQS but were formally redesignated for that NAAQS prior to its revocation and were designated attainment of the more stringent 2008 ozone NAAQS. In February 2019, the TCEQ submitted a SIP revision to the EPA that included a request that the BPA be formally redesignated to attainment for the one-hour ozone standard and that the EPA also consider the SIP revision as a second 10-year maintenance plan for the one-hour ozone standard. In September 2020, EPA partially approved the request to consider the SIP revision as a second 10-year maintenance plan but stated that it would not address the one-hour ozone standard portion of the submittal (85 FR 35041). EPA has taken the position that the agency lacks the authority to redesignate areas to attainment under the revoked standards.

Trends in ozone are used to demonstrate the substantial progress the BPA area has made in improving air quality and to demonstrate compliance with the NAAQS standards. Trend data comes from the BPA ozone monitoring network that consists of seven regulatory compliant ambient air monitors. The BPA has been attaining both the one-hour ozone NAAQS and the 1997 eight-hour ozone NAAQS since 2007 and has always be in attainment of the 2008 and 2015 standards. The one-hour ozone design value in the BPA area has decreased nearly 39% over the past 28 years from a design value of 150 ppb in 1990 to a design value of 91 ppb in 2017 (TCEQ 2019), which is well below the 124 ppb NAAQS threshold. In 2017, all regulatory monitors had expected exceedances less than the threshold of 1.0 per year (TCEQ 2019). Similarly, the 1997 eight-hour ozone design value has decreased 33 percent over the past 28 years, from a design value of 100 ppb in 1990 to a design value of 67 ppb in 2017 (TCEQ 2019), demonstrating that the area is below the 84 ppb threshold for the 1997 standards, the 75 ppb threshold for the 2008 standards and the 70 ppb threshold for the 2015 standard.

3.2. Climate

The region has a subtropical climate. Summers are hot and humid with prevailing southerly winds from offshore, while winters are cool and wet. The average annual high temperature is 78.3°F with an average annual low of 59.6°F. In winter, the average temperature is 55°F and the average daily minimum temperature is 44°F. In summer, the average temperature is 82°F and the average daily maximum temperature is 91°F. The average relative humidity in mid-afternoon is about 72 percent. The average annual total precipitation is about 60 inches. The average seasonal snowfall is 0.2 inches. Thunderstorms occur on about 67 days each year, and most occur in July and August.

Tropical depressions, tropical storms, and hurricanes are relatively common in the Gulf of Mexico. Hurricane season runs from June through September and, historically, the frequency of hurricanes making landfall along any 50-mile segment of the Texas coast is one in about every six years with annual probabilities of a strike in the study area being approximately 31 percent in any given year (Roth 2010). Typically, the study area will see three tropical storms and/or hurricanes over a four-year period. During these events, flooding is the most serious threat. In general, the weaker the system, the more efficient it is at producing heavy rains and catastrophic flooding. Most storms enter from the southeast, and curve north and northeast through eastern and central portions of Texas. Figure 4 shows the historical storm tracks of more significant storm events to affect the study area. The Engineering Appendix (Appendix A) has a detailed accounting of the history of coastal storms around the study area.

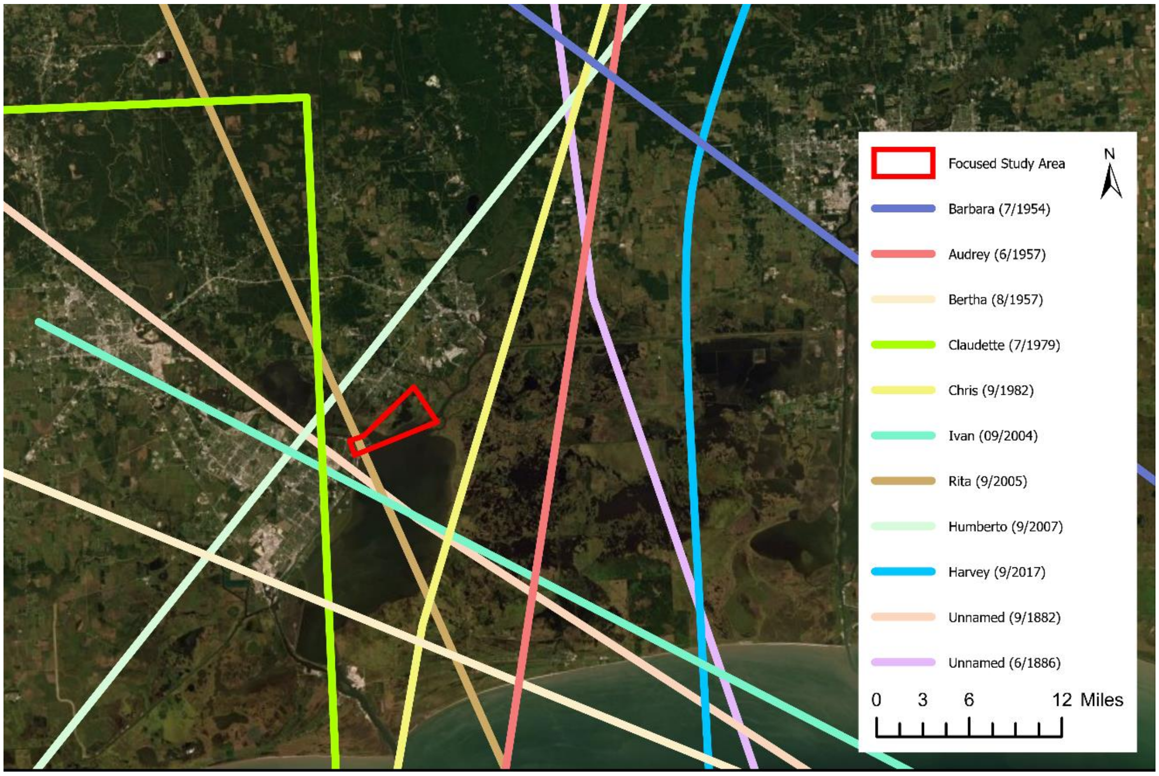

Figure 4. Historical storm tracks in and around the study area.

3.3. Water Resources

3.3.1. Hydrology

Modifications to regional hydrology have affected ecological and geological processes critical to the long-term integrity of coastal ecosystems in the Chenier Plain region. In general, the primary human induced activities that have affected coastal wetlands include construction of the SNWW and smaller navigation canals, oil, gas, and groundwater extraction, and channelization and deepening of natural waterways for navigation and inland drainage, as well as urbanization. Consequences have resulted in various ecological responses, some of which are directly responsible for the onset of others. For example, saltwater intrusion into historically freshwater marshes, introduction of tidal energies into historically non-tidal and micro-tidal marshes, reduction of freshwater and sediment inputs from slower historic sheet flows from prairies to marshes, and alteration of hydroperiods each contributes to changes in plant species composition, plant productivity, peat collapse, and erosive loss of organics marsh soils and eventually leads to the conversion of the vegetated emergent marsh to open water.

Another important hydrologic influence in the project area is controlled inflows. Historically, all of the water from the Sabine and Neches rivers drained directly into Sabine Lake. Today, Operation of Toledo Bend Reservoir and Steinhagen Reservoir for industrial and agricultural uses has altered the timing of freshwater flows. Water is now retained in the reservoirs during the spring when freshwater inflows are traditionally highest and released in the summer when inflow is low and electric generation needs are greatest.

The estuary exhibits very complicated circulation and salinity patterns. Freshwater enters the system via several tributaries, including the Sabine and Neches rivers, and other smaller inflows. The Neches River flows directly into Sabine Lake and the Sabine-Neches Canal, whereas the Sabine River flows into Sabine Lake, the Sabine-Neches Wildlife Refuge, and into Calcasieu Lake via the GIWW.

The project area is within the 100-year floodplain and is subject to frequent flooding from tidal surges and extreme weather events.

3.3.2. Surface Water

The study area is along the most northern boundary of the Sabine-Neches Estuary, where the Sabine and Neches rivers enter the Sabine Lake. The estuary includes Sabine Lake, the Sabine-Neches and Port Arthur Canals, and Sabine Pass, and covers about 100 square miles. In the estuary, freshwater from the Sabine and the Neches Rivers meets saltwater from the Gulf of Mexico. Although it is influenced by tide, the inland location of the estuary protects it from the full force of Gulf waves and storms. The estuary is important for fish, shellfish, and wildlife habitat and sport and commercial fishing.

Sabine Lake is a relatively large, shallow (averaging about 6.5 feet deep, except where dredging occurs), brackish natural water body on the Texas and Louisiana border about seven miles from the Gulf. According to the Sabine River Authority, the surface area of the lake is roughly 54,300 acres, making it one of the smallest estuaries on the Texas Coast. The lake supports extensive coastal wetlands around much of its perimeter including the study area. Its small volume coupled with large freshwater inflows from the Sabine and Neches Rivers cause it to turnover around 50 times per year.

Sabine Lake connects to the Gulf of Mexico via Sabine Pass, a seven-mile-long tidal inlet between the Gulf and the southern end of the lake. Historically, Sabine Pass was a narrow, shallow waterway; however, in the latter part of the 19th century, engineers constructed a ship channel (the SNWW) through the pass and lake that enables deep draft navigation to inland terminals on Sabine Lake. Since then, the SNWW has been expanded in length, depth, and width, and extended into the Neches and Sabine Rivers. Today, Sabine Pass connects Gulf mariners to several of the busiest ports in the U.S. – the Port of Beaumont and Port of Port Arthur along with numerous private dedicated terminals.

3.3.3. Groundwater

The study area overlies the Gulf Coast Aquifer. In Texas, the aquifer parallels the Gulf coastline from Louisiana to the border of Mexico, and contains various interconnected layers, some of which are aquicludes (impervious clay or rock layers). From bottom to top, the four main water-producing layers are the Catahoula, Jasper, Evangeline, and Chicot with the Evangeline and Chicot being main sources of fresh groundwater in the region. The maximum total sand thickness of the Gulf Coast Aquifer ranges from 700 feet in the south to 1,300 feet in the north. Freshwater saturated thickness averages about 1,000 feet throughout the aquifer. The depth to surficial groundwater in the study area is shallow and can be found at the existing ground surface. Because of the proximity to the estuary and higher salinity water influence, freshwater for most industrial, agricultural, and municipal use is obtained from surface water sources. For regulatory purposes, the study area is within the coastal zone and is not included in the major aquifer designation due to the presence of predominantly brackish water.

3.3.4. Water Quality

Section 305(b) of the Clean Water Act (CWA) requires states to assess surface and ground water quality and prepare comprehensive reports documenting water quality, which states submit to the USEPA biannually. In addition, Section 303(d) of the CWA requires states to prepare a list of impaired waters based on Total Maximum Daily Loads of pollutants and specify corrective actions. The Texas Commission of Environmental Quality enforces state water quality standards and prepares the state's comprehensive report for submittal to USEPA.

Based on the Texas Environmental Quality 303(d) list, three surface water sources have been identified as impaired. The Sabine River Tidal from the confluence of the Sabine Lake upstream to the confluence of Adams Bayou Tidal (0501_01) and the Neches River Tidal from the confluence with Sabine Lake to the top of first oxbow above Bird Island Bayou confluence (0601_01) are both impaired for bacteria in water (Recreation Use) and PCBs in edible tissue. Sabine Lake (2412_01) is impaired for PCBs in edible tissue.

3.3.5. Salinity

Sabine Lake is predominately brackish with salinity ranging from 15 ppt at Sabine Pass to 0 ppt at the northern end of the lake near Rainbow Bridge. Because the lake is also tidally influenced and water exchange patterns vary with the tides and wind, the fluctuating salinity levels can often be extreme and include significantly different surface and bottom measurements.

Tidal flow originating from the Gulf, the strength and intensity of winds, intensity of rainfall and associated river inflows, and depth of the SNWW and lake strongly influence salinity in Sabine Lake and in particular the project area. In Sabine Lake, a saltwater wedge has formed because the denser saltwater flows upstream along the bottom of the SNWW underneath the less dense freshwater inflows. The wedge then contributes to highly stratified conditions. When freshwater flows increase or decrease the saltwater wedge retreats lower in the lake or advances further north, respectively. The intrusion length depends on two parameters: river flow velocity and water depth.

During periods of normal rainfall, high-salinity water transported by the SNWW is buffered by controlled discharges from upstream reservoirs and have little effect on the salinity levels of Sabine Lake and the surrounding marshes. On the other hand, during periods of high flows, the SNWW, Sabine Lake, and surrounding marshes can experience occasional freshwater conditions (very low salinity levels near 0 ppt) due to large quantities of freshwater entering the system from the Sabine and Neches rivers. Conversely, during periods of drought, controlled freshwater in-flows are absent, allowing the saltwater wedge to move further upstream and increase salinities in the northern part of Sabine Lake and the surrounding marshes (the project area) to seawater levels (about 30 ppt) that remain high until controlled inflow resumes. Extreme conditions can be observed over several months and can greatly influence the surrounding marsh habitats, the estuary, and the fisheries.

The mean salinity values with a median flow range from 4.0 to 6.0 ppt, with the highest 33 percent of continuous salinity between 9.0 and 14.0 ppt. For low flow events, mean salinity values range from 14.0 – 18.0 ppt. (Brown and Stokes 2009)

3.4. Geologic Resources

Geological resources are defined as the topography, geology, soils, and mining of a given area. Topography describes the physical characteristics of the land such as slope, elevation, and general surface features. The geology of an area includes bedrock materials and mineral deposits. Mining refers to the extraction of resources (e.g. gravel). The principal geologic factors influencing the stability of structures are soil stability, depth to bedrock, and seismic properties. Soil refers to unconsolidated earthen materials overlying bedrock or other parent material.

3.4.1. Topography

The landscape is nearly flat, with marsh elevations throughout the study area presently hovering just above sea level (about 1.0 to 2.0 feet NAVD88) and open water areas at sea level or below. A historic containment dike is present along the southern boundary that separated the historic freshwater marsh from the saline marsh and Sabine Lake ranges in elevation from sea level where the dike has been breached to the original construction height of approximately +5.0 feet NAVD88. A similar containment dike exists along the western boundary but with most of the length of the dike ranging between 3.0 and 5.0 feet msl and only a couple of locations of breach.

3.4.2. Geology

The study area is within the West Gulf Coastal Plain section of the Coastal Plain physiographic province (Fenneman 1928) and within the Coastal Prairies subprovince, which is characterized by nearly flat geologic strata and topography with typically less than 1-foot-per-mile gradient (Bureau of Economic Geology 1996). Chenier plain and coastal plain sediments consisting of unconsolidated sand, silt, and clay occur at the land surface in the study area. The Chenier plain is characterized by two types of landforms: broad marshes containing organic clays and peat, and long, narrow relict beach features called “cheniers” that appear as ridges parallel to the coast. Chenier ridges form as a result of cyclic shoreline advance and retreat, and are mixtures of silt, sand, and shell fragments. They are slightly elevated features that attain elevations of 5 to 10 feet above sea level. These geologic materials were deposited by fluvial, tidal, littoral, and deltaic processes over the past 5,000 years (Fisher et al. 1973).

3.4.3. Soils

Soils within the project area are remnants of ancient floodplains and Gulf beaches consisting of old alluvium and marine sediment deposited by ancient streams and the Gulf. These deposits are mostly clayey and sandy soils and exhibit a wide range in textural differences due to their origin within historic floodplain systems.

Two principal soil associations found in the project area include Bancker mucky peat and Barnett mucky peat of the Bancker Series. The Bancker series consists of very deep, very poorly drained, very slowly permeable soils. These soils formed in very fluid clayey and organic sediments in intermediate or brackish coastal marshes. The sediments have been deposited under water and never air-dried and/or consolidated. The series is very fluid and susceptible to marsh erosion processes that allow the soil surface to be removed by water and alter the adapted plant community often leading to unvegetated barren areas covered with water. The Bancker series is an important part of the marine estuary ecosystem by providing an abundant amount of detritus. (NRCS 2006)

3.4.4. Coastal Erosion

The shoreline of Hickory Cove Bay has eroded due to the wave climate exacerbated by navigation traffic and wind waves generated across Sabine Lake Estuary. While some isolated areas have accreted or remained generally intact, much of the shoreline has experienced significant loss. The General Marsh Model, a decision support tool developed by Ducks Unlimited (2013), identified Hickory Cove bay as a high and medium priority candidate for shoreline protection because of shoreline erosion and historic and future anticipate loss.

Aerial imagery was assessed to determine shoreline change from 1989 to 2019 (Figure 5). Consistent with the General Marsh Model results, the central exposed region of the shoreline has eroded significantly to the point that the containment dike surrounding the marsh has been breached in multiple locations. This is allowing estuary water to enter the interior marshes where it continues to erode away sediments converting the area to open water.

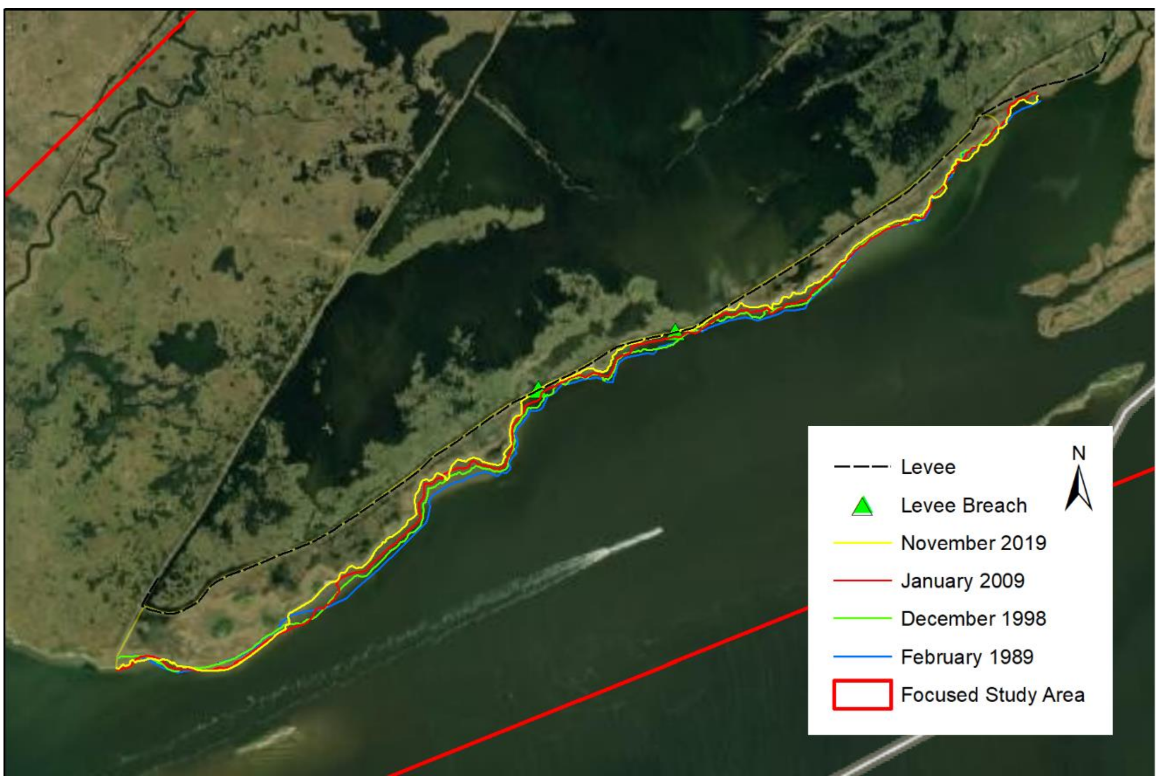

Figure 5. Hickory Cove shoreline change from 1989-2019

3.4.5. Mineral Resources

Mineral resources found near the study area in southeastern Texas and southwestern Louisiana include sand, gravel, salt, natural gas, crude oil, and sulfur (with associated crude oil). No active or inactive mineral resources are found within the proposed restoration footprints.

3.5. Biological Resources

Biological communities include plants and animals and the habitats in which they occur. They are important because: (1) they influence ecosystem functions and values; (2) they have intrinsic value and contribute to the human environment; and (3) they are the subject of a variety of statutory and regulatory requirements.

3.5.1. Habitats

There are two primary habitat types found in the project area: coastal wetlands and open water (Figure 6). The Coastal Wetland habitat type can be further classified as intermediate-brackish marsh and saline (salt) marsh in the project area (Figure 6). Delineation of habitat types in the project area were adapted from USGS (2010) and review of aerial imagery to account for increases in open water since 2010.

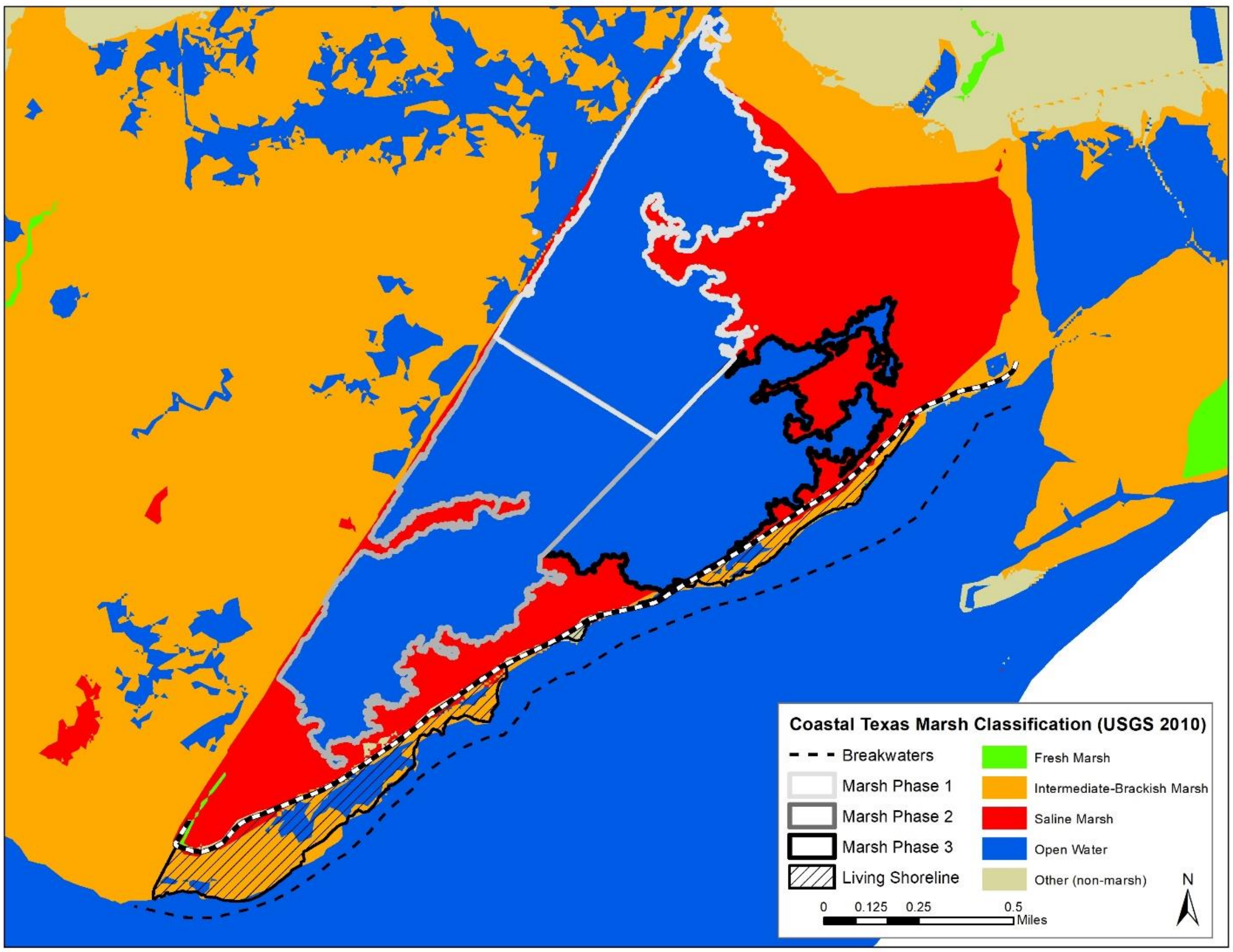

Figure 6. Habitat types in the project area using the USGS (2010) delineation of marsh types and aerial imagery analysis.

3.5.1.1. Open Water Habitats

Approximately 80 percent of the project area is considered inland open water habitat. As previously described, salinity in Sabine Lake in the project area seaward of the containment dike is highly dependent on the flows of the Sabine and Neches rivers and the location of the saltwater wedge and can range from 0.0 to over 30.0 ppt with salinity more typically between 4.0 and 18.0 ppt. Here the depth of habitat is shallow (<4.0 feet) and typically very turbid due to the two rivers merging in the project area. This area support little to no rooted vascular plants (submerged aquatic vegetation [SAV]). Phytoplankton are the most likely plant or animal species to occur in this habitat.

Figure 7. Hickory Cove shoreline

Salinity within the open water areas landward of the containment dike has much higher salinity (well over 18 ppt) because with every tidal3 surge that breaches the containment dike the higher salinity water gets trapped behind the containment dike and there are not sufficient freshwater flows to reduce salinities. SAV species include a number of rooted and floating aquatics such as wigeon grass (*Ruppia maritima*), several pondweeds (*Potamogeton spp.*), banana waterlily (*Nymphaea mexicana*), and American lotus (*Nelumbo lutea*).

Figure 8. Open water landward of the containment dike

3.5.1.2. Coastal Wetlands (Marshes)

Coastal marsh habitats provide important functions of improving water quality in the estuarine ecosystem, providing flood control benefits, and buffering inland habitats from tidal surges. In addition, marshes are extremely biologically productive and diverse and provide detrital input, which is the basis for the estuarine food chain.

Salinity is an important factor affecting historic trends in marsh habitat types within the project area over time. Project-area marsh type shifts occurred as salinity regimes varied spatially and temporally. Prior to Hurricane Rita in 2005, a containment dike in the project area minimized saltwater intrusion into the historically freshwater marsh landward of the containment dike. During Hurricane Rita, a breach occurred allowing higher salinity water into the interior marshes. The dike was repaired and limited further conversion of freshwater marshes to intermediate-brackish and salt marsh or open water. The dike was again breached in 2011 during Hurricane Ike and has continued to degrade over time. This has resulted in conversion of a significant area of freshwater marsh to salt marsh or open water. Salt marshes in the project area are restricted to areas within the containment dike, while intermediate-brackish marshes are found in areas where hydrologic connection to freshwater sheet flows and tidal influence occur on the outside of the dike.

Figure 9. Salt marsh landward of the containment dike.

Salt marshes are the least diverse of the three marsh types with water salinity averaging 18 ppt. Marshhay cordgrass (Spartina patens) dominates the vegetative community where the marsh is not being broken up by open water. Other common species found in the project area include smooth cordgrass/oystergrass (*Spartina alterniflora*), asters (*Baccharis spp.*), seashore saltgrass (*Distichlis spicata*), blackrush (*Juncus roemerianus*), saline marsh aster (*Symphiotrichum tenuifolium*), marshhay cordgrass (*Spartina patens*), and glasswort (*Salicornia spp.*). Additionally, common reedgrass/Roseau cane (*Phragmites australis*) is beginning to establish within salt marsh areas.

Intermediate-brackish marshes (salinity range of 3.0 to 18.0 ppt) in the project area is subjected to daily tidal action, but also receives some freshwater influence, and its water depths normally exceed that of salt marsh. The diversity and density of plant species are relatively high, especially when compared to salt marsh. Marshhay cordgrass is the dominate species in this habitat type. In areas with more frequent tidal inundation or where salinities tend to the higher end of the range, the co-dominant species include saltmarsh bulrush (*Bolboschoenus robustus*) and seashore saltgrass. Co-dominate species in lower salinity areas include seashore paspalum (*Paspalum vaginatum*), Olney three square (*Schoenoplectus americanus*), California bulrush/giant bulrush (*S. californicus*), and common reedgrass/Roseau cane. Bulltongue (*Sagittaria lancifolia*) and sand spikerush (*Eleocharis montevidensis*) are also commonly found in the lower salinity areas. Submerged aquatics such as pondweeds and southern waternymph (*Najas guadalupensis*) are abundant in intermediate marsh.

3.5.2. Fisheries

The region's coastal fishery is a warm water fishery with moderate to high numbers of salt and brackish water species in the Sabine estuary and the marshes surrounding the estuary. Most of the economically important saltwater fishes and crustaceans harvested in Texas spawn offshore, and then use estuarine areas for nursery habitat (Herke 1995). Nekton use of estuaries is largely governed by the seasons (Day et al. 1989). Different species use the same locations in different seasons, and different life stages of the same species use different locations. Aquatic species diversity peaks in the spring and summer and is typically low in the winter. Some marine species which use estuaries as nursery habitat also have estuarine-dependent life stages, typically larvae and juveniles. Larvae or juveniles immigrate into the project area during incoming tides and take advantage of the high productivity of the estuary.

Species typical of low-salinity areas include largemouth bass (*Micropterus salmoides*), crappie (*Pomoxis sp*), bluegill (*Lepomis macrochirus*), alligator gar (*Atractosteus spatula*), and blue catfish (*Ictalurus furcatus*). Species found in higher salinity areas include: speckled sea trout (*Cynoscion nebulosus*) Atlantic croaker, spot, Gulf menhaden, bay anchovy, red drum (*Sciaenops ocellatus*), black drum, southern flounder, blue crab (*Callinectes sapidus*), Gulf stone crab, brown shrimp (*Farfantepenaeus aztecus*), and white shrimp (*Litopenaeus setiferus*).

3.5.3. Wildlife

The marshes support a highly diverse and productive biological community and conservation of biological diversity in the study area is dependent on maintaining a continuum of fresh, intermediate-brackish, and salt marsh habitats. Plant and animal diversity is greater in the fresh and intermediate-brackish marshes than in the saline types. Intermediate- marsh receives the highest use of any of the marsh types by wintering and migrating waterfowl and many wading bird species. Fresh, intermediate, and brackish marshes are extremely important to migratory waterfowl.

The project-area marshes are located at the termini of the Mississippi and Central Flyways and provide wintering habitat for 26 species of waterfowl. Dabbling ducks, such as mallard (*Anas platyrhynchos*), gadwall (*Mareca strepera*), American widgeon (*M. americana*), pintail (*A. acuta*), northern shoveler (*Spatula clypeata*), green-winged teal (*A. carolinensis*), and blue-winged teal (*A. discors*), utilize marsh and shallow-water habitats within the project area. Diving ducks such as lesser scaup (*Aythya affinis*), ring-necked duck (*A. collaris*), and several species of mergansers (*Mergus sp.*), utilize larger ponds and open-water areas. Large populations of wintering white-fronted and snow geese (*Anser albifrons* and *A. caerulescens*) (with occasional Canada and Ross' geese [*Branta canadensis* and *A. rossii*]) seasonally inhabit the project area and surrounding marshes.

The project area also provides feeding and nesting habitat for numerous other migratory birds such as American coots (*Fulica americana*), rails and gallinules (Rallidae), bitterns, egrets and herons (Ardeidae), white-faced ibis (*Plegadis chihi*) and white ibis (*Eudocimus albus*). Other nongame birds such as the boat-tailed grackle (*Quiscalus major*), redwinged blackbird (*Agelaius phoeniceus*), eastern kingbird (*Tyrannus tyrannus*), cormorants (Phalacrocoacidae), anhinga (*Anhinga anhinga*), northern harrier (*Chordata hudsonius*), belted kingfisher (*Megaceryle alcyon*) and white pelican (*Pelecanus erythrorhnchos*) also use the project-area marshes.

Mammals that inhabit project-area habitats include nutria (*Myocaster coypus*), muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), river otter (*Lutra canadensis*), Virginia opossum (*Didelphis virginiana*), mink (*Neogale vison*), swamp rabbit (*Sylvilagus aquaticus*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), white-tailed deer (*Odocoileus virginianus*), and feral hog (*Sus scrofa*).

Reptiles and amphibian species found in the project area include American alligator (*Alligator mississippiensis*), western cottonmouth (*Agkistrodon piscivorus*), red-eared turtle (*Trachemys scripta*), common snapping turtle (*Chelydra serpentina*), softshell turtle (*Apalone spp.*), treefrogs (Hylidae), bullfrog (*Rana catesbeiana*) and pig frog (*R. grylio*).

Invertebrate populations are an essential food resource for migratory birds and estuarine fishery species. Various amphipods, midges, mysid shrimp, grass shrimp, crayfish, and numerous crabs are present within all marsh habitats in the focused study area. Some of these invertebrates occur in tremendous quantities. Mosquitoes, biting flies, chiggers, and imported fire ants (*Solenopsis invicta*) are also common. Common butterfly species include monarch (*Danaus plexippus*), little yellow (*Pyristitia lisa*), and Gulf fritillary (*Agraulis vanilla*e) butterflies. Common dragonfly species include the common green darner (*Anax junius*) and seaside dragonlet (*Erythrodiplax berenice*).

Native rangia clams (*Rangia cuneata*) historically occurred throughout the focused study area, thriving in intermediate and brackish marshes, but have been reduced in numbers by saltwater intrusion throughout the system. Periwinkle snails (*Littoraria irrorata*) are found in the salt marshes and in the brackish marsh with the higher salinity levels where smooth cordgrass has become established. Fiddler crabs (*Uca sp.*) are found from the high tide line in high marshes to the intertidal zone across portions of the project area.

3.5.4. Invasive and Noxious Plant and Animal Species

Invasive species are non-native species whose populations tend to grow and spread, and cause harm to native biodiversity, the economy, or health. Invasive species are one of the most pervasive, widespread threats to indigenous biota. Several non-native animal and plant invasive species have been recorded in or near the project area and could have the potential to establish in the project area at some point in the future including:

- Chinese tallowtree,
- Deep-rooted sedge,
- Water hyacinth (Eichhornia crassipes),
- Alligator weed (Alternathera ohiloceroides),
- Water lettuce (*Pistia stratiotes*),
- McCartney rose (*Rosa bracteata*),
- Vasey grass (Paspalum urvillei),
- Johnsongrass (Sorghum halepense),
- Eurasian water milfoil (*Myriophyllum spicatum*),
- Hydrilla (Hydrilla verticillata),
- Common salvinia (*Salvinia minima*),
- Giant salvinia (*S. molesta*),
- Japanese honeysuckle (*Lonicera japonica*),
- Red imported fire ants,
- Nutria, and
- Feral hogs.

Noxious species similarly deteriorate habitats and cause damage, except that the species are native. Noxious plant species include eastern baccharis (*Baccharis halimifolia*), big-leaf sumpweed (*Iva frutescens*), rattlebox (*Sesbania drummondii*), common reed (*Phragmities communis*) and cattail (*Typha spp*).

3.6. Protected Species

3.6.1. Threatened and Endangered Species

Nineteen ESA-listed species have been identified in the USFWS Official Species List dated August 19, 2021 or on the NOAA Texas' Threatened and Endangered Species List updated September 1, 2021 (Table 1). There is no critical habitat designated in the focused study area. For a more detailed discussion on the habitat requirements, historic and current occurrence, and threats to each species, refer to the Biological Evaluation (BE) prepared for this study (Appendix A-2)

Table 1. Federally Listed Threatened and Endangered Species Potentially in the Project Area

Species	Status	Jurisdiction	Preferred Habitat	Suitable habitat in the project area?
Birds				
Eastern black rail Laterallus jamaicensis ssp. jamaicensis	T	USFWS	Use tidally or non-tidally influenced wetlands ranging in salinity from salt to brackish to fresh. Require dense vegetation at least	Marginal – generally marshes are too deep and not enough higher elevation habitat to escape tides; suitable quality habitat nearby
Piping plover Charadrius melodus	T	USFWS	Wintering habitat along the Texas coast can be broadly characterized as emergent tidal or washover areas that are unvegetated to sparsely vegetated with wet to saturated soils near water.	No – No records of the species within 5 miles of the project area. Areas of exposed mudflats or unvegetated shorelines have a high clay content and would not be suitable for prey species.
Red knot Calidris canutus rufa	T	USFWS	Found primarily in intertidal, marine habitats-- sandy beaches, saltmarshes, lagoons, mudflats of estuaries and bays, and mangrove swamps that contain an abundance of invertebrate prey -- especially near coastal inlets, estuaries, and bays outside of the breeding season. Stopover habitat includes river shorelines with muddy/sandy substrate.	No – No records of the species within 5 miles of the project area. Areas of exposed mudflats or unvegetated shorelines have a high clay content and would not be suitable for prey species.
Whooping crane Grus americana	T	USFWS	Winters along the Gulf Coast and breeds in Canada. On wintering grounds in Texas, they use estuarine marshes, shallow bays, and tidal flats, sometimes using nearby farms. Salt grass, saltwort, smooth cordgrass, glasswort, and sea oxeye dominate marshes, with Gulf cordgrass on the margins	Yes -- Members of the experimental population in Louisiana frequently forage near the project area in marsh areas similar to those found in the project area.
Fish				
Oceanic whitetip shark Carcharhinus longimanus	T	NMFS	Tropical and subtropical seas worldwide. The species is pelagic, generally remaining offshore in the open ocean, on the outer continental shelf, or around oceanic islands in water depths greater than 184 m (~604 feet). They have a strong preference for the surface mixed layer in warm waters above 20°C (68°F).	No —Project area does not support deep marine waters
Giant manta ray Mobula birostris	T	NMFS	Inhabits tropical, subtropical, and temperate clear bodies of water worldwide, and are commonly found offshore, in oceanic waters and near productive coastlines, although they have been observed in estuarine waters near oceanic inlets, with the use of these waters as potential nursery grounds.	No —Outside species known range; estuarine waters are too turbid for

Mammals				
West Indian manatee Trichechus manatus	T	USFWS	Found in marine, estuarine, and freshwater. In winter, seek out warm water sites such as springs, deep water areas, areas thermally influenced by the Gulf Stream, and utility plant discharge sites. During spring and summer, leave warm water sites and travel great distances. No known resident populations in Texas.	Marginal -- Historical records from Sabine Lake, although considered extremely rare in Texas. Presence highly unlikely due to lack of SAV and turbidity; however, it cannot be ruled out with certainty that the species could not occur in the area
4 Whale Species Fin whale (Balaenoptera physalus); Sperm whale (Physeter macrocephalus); Sei whale (B. borealis); Rice's whale (B. ricei)	E	NMFS	Found in warmer waters of the Gulf of Mexico on the continental shelf edge and slope. Prefer deeper waters of oceanic areas far from the coastline.	No – Outside species known range; project area does not support deep marine waters
Reptiles				
Green sea turtle Chelonia mydas	T	USFWS/ NMFS	Found in inshore and near shore waters of the Gulf of Mexico. Primarily use shallow habitats such as lagoons, bays, inlets, shoals, estuaries, and other areas with abundant marine algae and seagrasses. Coral reefs and rocky outcrops are often used as resting areas. Nest on beaches, but no nesting recorded from upper Texas coast.	No – project area does not support seagrasses or an abundance of marine algae. Salinity is on average too fresh for the species.
Hawksbill sea turtle Eretmochelys imbricata	E	USFWS/ NMFS	Prefer clear offshore waters of mainland and island shelves in water less than 70 ft deep and are most common where coral reef formations are present. No nesting recorded from the upper Texas coast.	No – no occurrence records from Sabine Lake; project area does not support clear marine waters and is generally too fresh for the species
Kemp's Ridley sea turtle Lepidochelys kempii	E	USFWS/ NMFS	Adults found near the coastline in habitats that typically contain muddy or sandy bottoms where prey can be found. Nesting occurs on sandy beaches. Historic nesting along the beaches of Jefferson County, but none recorded in the last several decades.	No – salinity is on average too fresh for the species and the project area is too shallow (<4 ft), which is supported by the lack of historic foraging records that are only as far north as Sabine Pass.
Leatherback sea turtle Dermochelys coriacea	E	USFWS/ NMFS	Mainly pelagic, inhabiting the open ocean and seldom approaches land except for nesting. Nest on beaches but no records from the upper Texas coast.	No -- Project area does not support deep marine waters
Loggerhead sea turtle Caretta caretta	T	USFWS/ NMFS	Transient species along the Texas coast and in Texas bays and estuaries. Prefer shallow inner continental shelf waters and occur only very infrequently in bays. Nest on open sandy beaches but no records from the upper Texas coast.	No – project area waters are generally too fresh and turbid for the species

3.6.2. Migratory Birds

The project area is within a larger region that is one of the most important waterfowl areas in North America that supports both wintering and migration habitat for significant numbers of continental duck and geese populations using the Central and Mississippi Flyways. Coastal wetlands, such as those found in the project area, are primary wintering sites for dabbling ducks, including northern pintail (*Anas acuta*), gadwall (*Anas strepera*), readhead (*Aythya americana*), lesser scaup (*Aythya affinis*), and white-fronted geese (*Anser albifrons*). Throughout the region, these crucial wetlands winter more than half of the Central Flyway waterfowl population. The region also supports year-round habitat for over 90 percent of the continental population of mottled ducks (*Anas fulvigula*) and serves as a key breeding area for whistling ducks (*Dendrocygna* spp.) and purple gallinule (*Porphyrio martinicus*). In addition, hundreds of thousands of waterfowl use the region as stopover habitat while migrating to and from Mexico and Central and South America. The most important waterfowl habitats in the area are coastal marsh, shallow estuarine bays and lagoons, and wetlands on agricultural lands on rice prairies.

The USFWS published the Birds of Conservation Concern (BCC) 2008 in December 2008 with the goal of identifying migratory and non-migratory birds beyond those already protected under Endangered Species Act with the highest conservation priorities. Birds on the BCC lists include nongame birds; gamebirds without hunting seasons; candidates for listing per the Endangered Species Act, proposed endangered or threatened species; and recently delisted species. The project area is in Bird Conservation Region (BCR) 37—Gulf Coastal Prairie and the terminus of the Central Flyway, which lists 27 wetland-dependent species, 12 prairie grassland-dependent species, and four woodland or shrub-dependent species. Suitable habitat in the project area does not exists for any of the prairie grassland-, woodland- or shrub-dependent species.

Table 2 shows the wetland-dependent species listed on the BCC and includes migratory bird species that may be present in the project area as listed on the USFWS IPaC Report obtained for the project area. The eBird database was consulted to determine records/sightings of the species and habitat needs.

Table 2. Migratory Birds of Conservation Concern Potentially Occurring in the Project Area.

BCC-BCR 37		
American bittern	Short-billed dowitcher (nb)	Peregrine falcon (b)(nb)
Long-billed curlew	Least tern (c)	Least bittern
Seaside sparrow	Nelson’s sharp-tailed sparrow (nb)	Sandwich tern
Black rail	Yellow rail (nb)	Marbled godwit
Red knot (roselaari ssp.) (nb)	Snowy plover	Whimbrel (nb)
Red knot (rufa ssp.) (nb)	Wilson’s plover	Hudsonian godwit (nb)
American oystercatcher	Band-rumped storm petrel (nb)	Sprague’s pipit (nb)
Solitary sandpiper (nb)		
IPaC		
Common Loon	Double-crested cormorant	Brown pelican
King rail	Red breasted merganser	Willet
Ring-billed gull	Royal Tern	
Red-headed woodpecker	Prothonotary warbler	

On Both Lists		
Bald eagle (b)	Gull-billed tern	Reddish egret
Lesser yellow legs (nb)	Black skimmer	

Bold text = suitable habitat and records within 5 miles of the project area
Italicized text = very limited, marginal or no suitable habitat and records within 5 miles of the project area
Plain text with highlight = potential suitable habitat but no records within 5 miles of the project area
Plain text = no suitable habitat and/or no records within 5 miles of the project area

3.6.3. Essential Fish Habitat

The project area is identified as Essential Fish Habitat (EFH) for postlarval, juvenile, and sub-adult life stages of white shrimp, brown shrimp, and red drum. The project area contains marginal to high quality EFH habitats for each of the referenced managed species. EFH requirements vary depending upon species and life stage (Table 3). Categories of EFH in the project area include estuarine emergent wetlands, marsh edge, estuarine water column, submerged aquatic vegetation, and estuarine water bottoms. Detailed information on Federally managed fisheries and their EFH is provided in a series of Fishery Management Plans for the Gulf of Mexico prepared by the Gulf of Mexico Fishery Management Council (GMFMC).

Table 3. Essential Fish Habitat for Federally Managed Species in the Project Area

Species	Life Stage	EFH
brown shrimp	post larval/juvenile	Marsh edge, submerged aquatic vegetation
	subadult	same as post larval/juvenile
white shrimp	post larval/juvenile	Marsh edge, submerged aquatic vegetation
	subadult	same as post larval/juvenile
red drum	post larval/juvenile	Submerged aquatic vegetation, estuarine mud bottoms, marsh/water interface
	subadult	Mud bottoms

In addition to being designated as EFH for white shrimp, brown shrimp, and red drum, aquatic habitats affected by the project provide valuable nursery and foraging habitats for other economically important fishery species including Atlantic croaker, striped mullet, Gulf menhaden, and blue crab. Those estuarine-dependent species serve as prey for other species managed by the GMFMC (e.g red drum, mackerels, snappers, and groupers) and highly migratory species (e.g. billfishes and sharks) managed by the National Marine Fisheries Service (NMFS).

3.6.4. Marine Mammals

The common bottle nosed dolphin (*Tursiops truncatus*) is the most likely marine mammal occurring in Sabine Lake. Other species of dolphins and whales are primarily restricted to deeper offshore waters; therefore, it is unlikely that any of these species would occur in or near the project area. Bottle nosed dolphins have been observed in the deeper waters of the shipping channels and at least five reports of stranded dolphins from Sabine Lake and Sabine Channel have been reported. However, no studies regarding population structure or abundance have been done (Phillips and Rosel 2014). Historical records of the West Indian manatee occurring in Cow Bayou (upstream of the project area along the Sabine River) exist (Schmidly and Bradley 2016); however, none have been recently documented using the area and are considered an extremely rare species in Texas.

3.7. Cultural Resources

The study area was examined for the presence of any known historic properties using the Texas Historical Commission's (Atlas) database. This review found nine previous terrestrial cultural resource surveys and five maritime cultural resources surveys that took place within the study area (Table 4). The proposed dredge placement localities for living shoreline have been surveyed in their entirety. The breakwater placement locations and marsh dredge placement localities have not been previously surveyed. Currently, 22 known terrestrial archaeological sites have been identified within the focused study area. Twenty-one terrestrial archaeological sites present within the study area were identified prior to previous cultural resource surveys being conducted (Table 5). All 22 identified archaeological sites are considered unevaluated for the National Register of Historic Places (NRHP). Five additional sites are located within 1 kilometer of the focused study area (Table 6). No historic properties or districts listed on the NRHP or cemeteries are present within the focused study area or within 1 kilometer of the study area. Two Texas historical markers for the Rainbow Bridge are located within 1 kilometer of the study area. The dike surrounding the marsh is less than 50 years old and is not eligible for consideration for the NRHP.

Table 4. Cultural Resource Surveys within (or partially within) the Study Area

Date of Survey	Sponsor	Type of Survey	Identified Resources within the Study Area
2021	Blue Marlin Offshore Port	Maritime	None
2019	Sabine-Neches Navigation District	Maritime	None
2010	TRC-Sempra	Maritime	None
2010	T Baker Smith	Maritime	None
2004	Sempra Pipelines and Storage	Terrestrial	None
2003	USACE - Galveston	Maritime	None
1995	USACE - Galveston	Terrestrial	None
1986	USACE - Galveston	Terrestrial	None
1986	USACE - Galveston	Terrestrial	None
1984	USACE - Galveston	Terrestrial	None
1982	USACE - Galveston	Terrestrial	None
1977	USACE - Galveston	Terrestrial	None
1973	USACE - Galveston	Terrestrial	41OR79

1973	USACE - Galveston	Terrestrial	41OR17, 41OR18, 41OR19, 41OR20, 41OR21, 41OR29, 41OR30, 41OR31, 41OR32, 41OR33, 41OR41, 41OR43, 41OR44, 41OR45, 41OR46, 41OR47, 41OR48, 41OR75, 41JF18, 41JF19, 41JF20

In 1973, the focused study area was surveyed for terrestrial archaeological sites prior to being used for dredge placement. Access to the project area marsh dredge placement areas for survey was determined to be impossible and a safety hazard due to a high-water table with standing water and thick vegetation. Survey was limited to shorelines that were accessible by boat and fly over by helicopter (McGuff and Roberson 1974). All of the known sites within the focused study area are shell middens. Twenty sites were recorded in 1940 as they were actively being mined for shell. One site was recorded in 1956 at the same time it was being excavated and destroyed. One site was identified in 1973 with the description that a large portion of this site had been removed during dredging activities. During the 1973 survey, none of the sites recorded between 1940 and 1956 could be accurately relocated and were instead lumped together into 3 locals (Table 5). The 3 locals were described as completely destroyed or in very poor condition having been mostly destroyed by shell mining and continued erosion. In the time since that survey, dredge material has been placed in the bulk of the feasibility study area including where the remnants of all 16 shoreline sites within the direct project impact area were located.

Table 5. Cultural Resources within the Study Area

Site Numbers	NRHP Eligibility	Site Type	Date Recorded	Status in 1973
41OR17, 41OR18, 41OR19, 41OR20, 41OR21	Undetermined	Shell Midden	1940	Indistinguishable from nearby sites, in very poor condition from erosion and shell mining
41OR29, 41OR30, 41OR31, 41OR32	Undetermined	Shell Midden	1940	Indistinguishable from nearby sites, in very poor condition from erosion and shell mining
41OR33	Undetermined	Shell Midden	1956	Destroyed
41OR41	Undetermined	Shell Midden	1940	Destroyed
41OR43, 41OR44, 41OR45, 41OR46, 41OR47	Undetermined	Shell Midden	1940	Indistinguishable from nearby sites, in very poor condition from erosion and shell mining
41OR48	Undetermined	Shell Midden	1940	Destroyed
41OR75	Undetermined	Shell Midden	1940	Very poor condition from erosion and dredge deposition

41OR79	Undetermined	Shell Midden	1973	Partially removed from dredging activities
41JF18	Undetermined	Shell Midden	1940	Destroyed
41JF19	Undetermined	Shell Midden	1940	Destroyed
41JF20	Undetermined	Shell Midden	1940	Destroyed

Table 6. Cultural Resources within 1 km of the Study Area

Site Number	NRHP Eligibility	Site Type
41OR36	Undetermined	Shell Midden
41OR73	Ineligible	Surface Shell Scatter
41OR74	Undetermined	Destroyed Shell Midden
41OR77	Undetermined	Shell Midden
41JF17	Undetermined	Shell Midden

3.8. Socioeconomics/Economics

The project area is within the Beaumont-Port Arthur Metropolitan Statistical Area (MSA). The Beaumont-Port Arthur MSA is a three-county region composed of Hardin, Jefferson, and Orange Counties in southeast Texas and is known as the Golden Triangle. The golden refers to the wealth produced from the Spindletop oil strike near Beaumont, Texas in 1901, and the triangle refers to the area between the cities of Beaumont, Port Arthur, and Orange, Texas.

Sabine Lake and its associated water bodies and marshes support a significant commercial harvest of catfish, brown and white shrimp, and blue crab. The marshes surrounding Sabine Lake, including the project area, also provide high-quality wintering habitat for an abundance of migratory waterfowl important to sport hunters and the hunting-related economy of the region. Alligator and furbearer harvests are also extensive in the region. Numerous private landowners and leaseholders have made substantial investments to implement plans to maintain and enhance waterfowl habitat values, and landowners obtain substantial revenues from hunting and fishing leases.

The project area is in census tract 48361022400, which has an estimated population of 5,403 people between 2014 and 2018. Based on aerial imagery, the nearest communities are greater than 1.5 miles north of the project area. According to the 2014-2018 American Community Survey (ACS) Report, approximately seven percent of the population (383 individuals) are of color with 96 percent (5,333 individuals) of the population reporting as white, two percent (34 individuals) reporting as black, one percent (34 individuals) reporting as Asian, and less than one percent (21 individuals) reporting as American Indian. The total Hispanic population is approximately three percent or 167 individuals. Of the 2,024 households in the census tract, 44 households (2%) that are linguistically isolate of which 37 households (84%) speak Spanish and 7 households (16%) speak other Indo-European languages. Additionally, 41 percent of all households have income less than $50,000 and 19 percent are considered low income. Based on the ACS report and review of the Environmental Protection Agency (EPA) Environmental Justice Mapping and Screening Tool (EJSCREEN), the project area is not within an area identified as an Environmental Justice population (an area in which minority and low-income populations make up more than 50 percent of the census tract).

3.9. Aesthetics and Recreation

The Lower Neches Wildlife Management Area (WMA) is the nearest public land to the project area and borders the western edge of project area. The WMA is designated for low-density recreational activities such as hunting, fishing, hiking, wildlife observation, photography, environmental education, and interpretation. All of the project area, with the exception of the open waters of Sabine Lake, is private land owned by the Hawk Club, a private hunting club. Recreational activities in the project area are at the discretion of the landowner and are typically managed through an ownership agreement.

From an aesthetic perspective, the landscape is relatively flat, with marsh elevations throughout the study area presently hovering just above sea level (about +0.0 to +1.5 feet NAVD88). Topographic highs of a few inches to 5 feet are generally limited to the containment dike, spoil mounds along dredged channels, along elevated roads and cattle trails. Man-made features within the project area are limited to the containment dike and access trails and visual acuities to marine shipping or recreational boat traffic, otherwise the area is largely undeveloped and provides a serene environment.

3.10. Hazardous, Toxic and Radioactive Waste

The potential impacts from HTRW related to construction activities were considered in accordance with USACE ER 1165-2-132, “Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects”, dated June 26, 1992. Per the ER, Section 4.a.(1), “Dredged material and sediments beneath navigable waters proposed for dredging qualify as HTRW only if they are within the boundaries of a site designated by the EPA or a state for a response action (either a removal action or a remedial action) under CERCLA, or if they are a part of a National Priority List (NPL) site under CERCLA.” The ER does not require a specific method for performing this HTRW surveys but does require that HTRW concerns be assessed and impacts and their costs reported and/or approximated, as necessary for each Civil Works project. HTRW is a programmatic definition used throughout the USACE to assess impacts, list and approximate costs associated with environmental pollutants released to the environment on Corps property and Corps Civil Works projects. For this report, HTRW impact costs were not approximated. The full ASTM Phase I ESA or AAI procedure was not followed and RECS were not identified for any HTRW concerns/impacts while preparing this report. Therefore, none of the following was performed: site specific reconnaissance/property visit; Sanborn Maps; historical aerial photos and topographic maps; personal property owner interviews; search of a commercial CERCLA/RCRA/other local/state pollutants environmental database; City Directory.

The survey conducted in this report is based on information available from the Environmental Protection Agency (EPA) and the Texas Commission of Environmental Quality (TCEQ) on response actions under CERCLA. The survey was conducted centered on the subject property, near Bridge City, at a radius of two miles. Review of the EPA NPL and RCRA database found no sites within the study area (Figure 10). Review of the TCEQ RCRA Corrective Action, Brownfield, and Solid/Hazardous Waste Permit facilities found no sites within the study area

(Figure 11). Therefore there are no known high or low impact HTRW problems expected from the proposed activity.

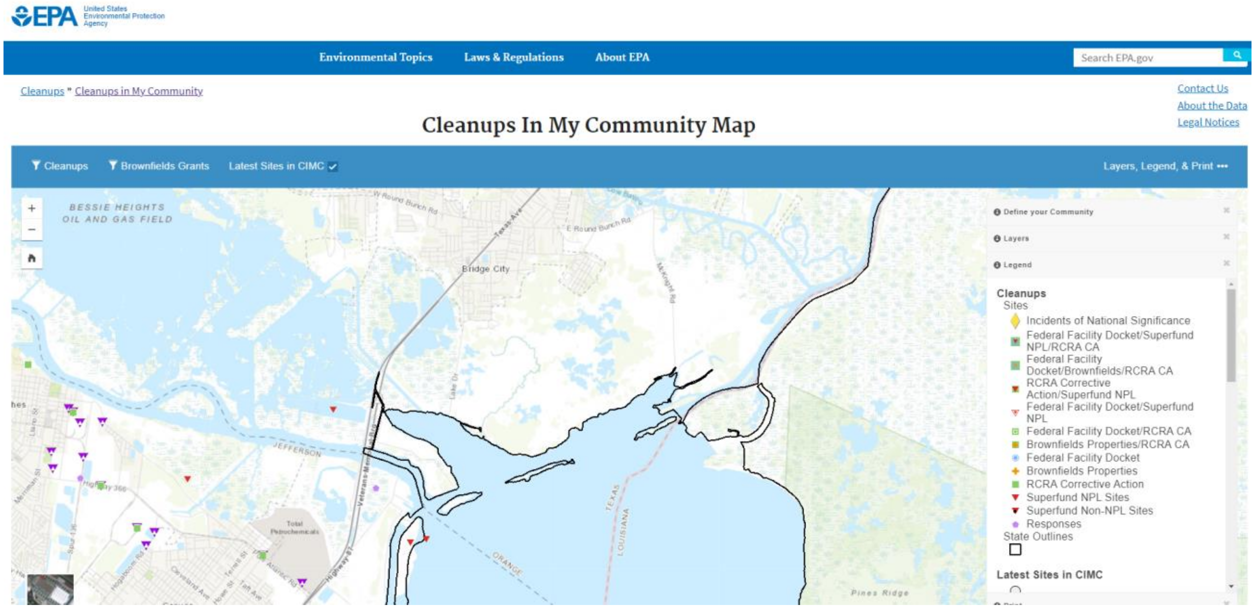

Figure 10. EPA NPL and RCR Sites with Approximate Survey Area Centered (https://www.epa.gov/cimc)

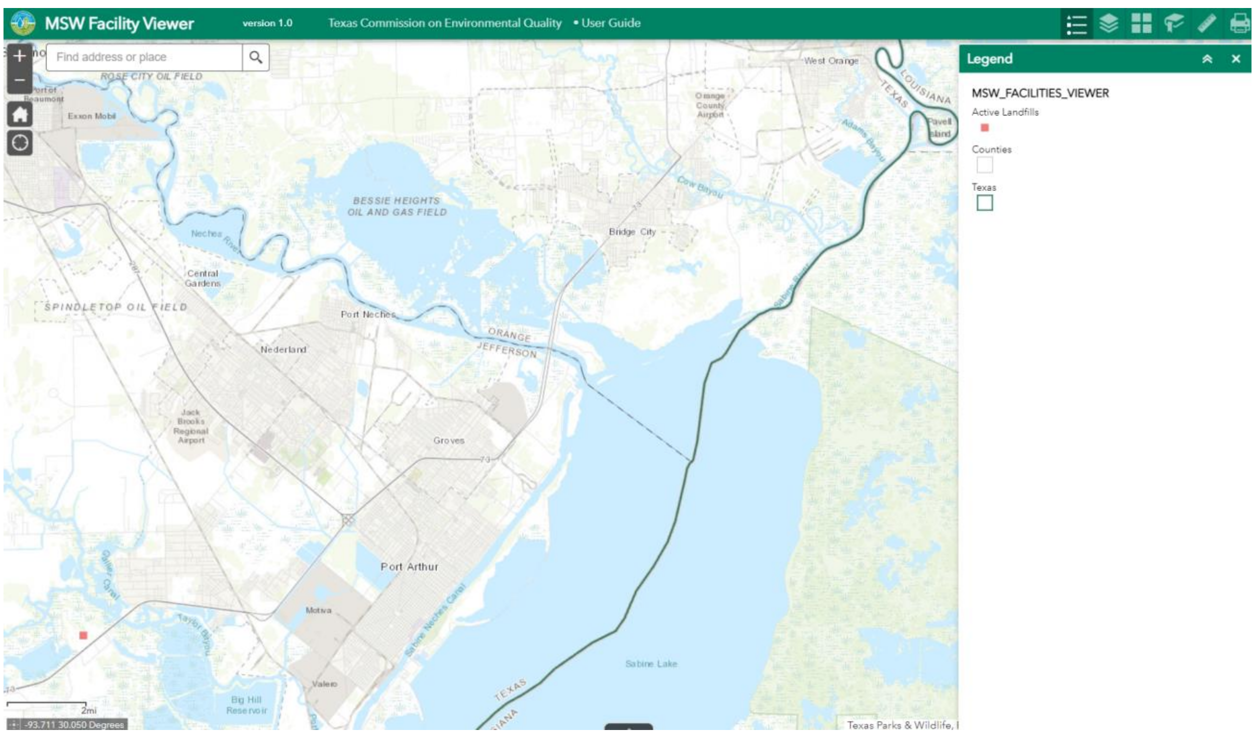

Figure 11. TCEQ Waste Facility Sites with Approximate Survey Area Centered (https://www.tceq.maps.arcgis.com/)

There may be unknown HTRW or pollutant impacts to the study area which were not fully disclosed and listed. These types of unknown HTRW impacts could also consist of newly discovered HTRW or buried historical type HTRW that is not observed on the land surface or not found from CERCLA databases. Newly discovered HTRW can sometimes be derived from residual (leftover) forms of contamination existing within the soils, soil vapor, air, surface water and groundwater media from releases of HTRW from known and listed HTRW sites. This occurs when undefined portions of the remaining known residual HTRW releases are encountered at known HTRW properties.

4.0 Plan Formulation (NEPA Required)

This chapter describes the plan formulation process. Plan formulation is the process of building alternative plans that meet planning objectives and develop alternatives within the planning constraints. Alternative plans are a set of one or more management measures functioning together to address one or more planning objectives. A management measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives.

The planning process for this study was driven by the problems, opportunities and objectives presented in Chapter 1. The planning process helped create and evaluate alternative plans to identify solutions to providing for beneficial placement of material dredged from the Sabine River.

Plan formulation for Hickory Cove Marsh Section 1122 has been conducted in accordance with the six-step planning process described in *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (1983) and the *Planning Guidance Notebook* (ER 1105-2-100, dated April 2000). The six steps in the iterative plan formulation process are:

1. Specify the water and related land resources problems and opportunities of the project area;
2. Inventory and forecast existing conditions;
3. Formulate alternative plans;
4. Evaluate alternative plans;
5. Compare alternative plans; and
6. Select the recommended plan

As noted in Section 1.0, the feasibility phase for the Section 1122 Pilot Project Program is being carried out similar to a CAP Section 204 Beneficial Use of Dredged Material study. This decision is based on the fact that Section 1122 of WRDA 2016 amends Section 204 and that any costs to implement the selected pilot projects beyond transportation and placement of dredged material would be cost shared in accordance with Section 204, as noted in the implementation guidance issued for Section 1122 of WRDA 2016. Additionally, utilizing the general CAP 204 process as a roadmap for the feasibility phase of the Section 1122 Pilot Project Program increases study and implementation efficiency. However, it is important to recognize that there will be divergences from the CAP Section 204 plan formulation and comparison processes inherent to the specific innovation-driven goals of the pilot project program compared to a typical

USACE beneficial use of dredged material project. These differences will be called out, as necessary, throughout the remainder of this feasibility report.

4.1. Relevant Past Reports

The planning process included a review of prior studies relevant to the beneficial placement of material dredged during routine maintenance of the area channels. There were no prior evaluations of BU for dredge material from the Sabine River. Recent restoration efforts were consulted to assess features type and location, engineering design, construction techniques, and performance metrics to apply lessons throughout the plan formulation process.

Study/Project	Location	Relevance to HCM Study
Old River Cove Restoration (TPWD, 2008)	Lower Neches Wildlife Management Area, Orange, Texas	Marsh restoration using dredge material and plantings at site closer to Hickory Cove Marsh with similar needs.
Jefferson County Ecosystem Restoration (USACE, 2019)	Jefferson County, Texas	Marsh restoration using dredge material.
Black Lake Supplemental Beneficial Use Disposal Area (CPRA, 2020)	Cameron Parish, Louisiana	Beneficial use of dredged sediment to create marsh.
Lake Borgne Shoreline Protection (CPRA, 2020)	Lake Borgnem St. Bernard Parish, Louisiana	Breakwater protecting marsh habitat along lake.
GIWW Perry Ridge West Bank Stabilization (CPRA, 2020)		Marsh restoration with plantings and breakwater protection along a GIWW tributary of the Sabine River.
Shoreline Protection Emergency Restoration (CPRA, 2020)	Plaquemines Parish, Louisiana	Plantings along 1.4 miles of shoreline to help stabilize connected marsh.
West Sabine Refuge Marsh Creation (CPRA, 2020)	Cameron Parish, Louisiana	Marsh restoration east of Sabine Lake.

Table 7 - Relevant Past Reports

4.2. Problems, Needs and Opportunities

The plan formulation process builds upon a thorough assessment of the relevant problems, needs and opportunities within the study area.

4.2.1. Problem Statement

Regional Sediment Management studies are an opportunity to address multiple regional problems. The Hickory Cove Marsh is at risk of being lost due to its exposure to coastal forces. Ship wakes from the adjacent waterway contribute to erosion at the site.
Coastal forces erode sediments from coastal marshes and once they transition to open water, habitat is lost. Resources along the SNWW are subject to hydrodynamic stresses such as waves, tides, and sea level rise. Changing conditions within Hickory Cove Marsh lead to the loss of critical habitat for two high priority waterfowl, Mottled Ducks and Northern Pintail, as identified by the North American Wetlands Conservation Act. Northern Pintail are a wintering and migrant waterfowl to the Texas Coast, whereas, Mottled Ducks are year-round residents. Maintenance dredging needs within the Galveston District exceed the available funding, requiring thoughtful management and budgeting to support navigation needs. The Sabine River maintenance dredging has been limited by availability of placement areas with easements to allow for placement of dredge material. While the Federal Government is required to pay 100% of the maintenance dredging a placement area improvement costs, it is the non-Federal sponsor's requirement to provide all necessary Lands, Easements, and Right-of-way needed for the disposal of the maintenance dredge material.

4.2.2. Need for Action

The shoreline of Hickory Cove Bay has eroded due to the wave climate exacerbated by navigation traffic and wind waves generated across Sabine Lake Estuary. While some isolated areas have accreted or remained generally intact, much of the shoreline has experienced significant loss. The General Marsh Model, a decision support tool developed by Ducks Unlimited (2013), identified Hickory Cove bay as a high and medium priority candidate for shoreline protection.

A containment dike was initially built at the perimeter of the site to reduce exposure of the marsh to coastal forces, but it was also vulnerable to wave action that caused repeated breaches. It currently has large gaps and is insufficient to prevent marsh degradation over time. In addition to navigation traffic subjecting the shoreline to erosive forces, Hickory Cove's shoreline is along the northern boundary of the lake with a significant fetch leaving it vulnerable to wind-driven and ship induced wave action. Attenuating waves is necessary to mitigate marsh degradation in these conditions.

The proposed action is also necessary to support continued navigation uses in the region. Surrounding parcels are privately owned, and placement areas require upgrades to accept additional material, or are too far for cost effective dredging and sediment piping. Marsh restoration at the Hickory Cove Marsh would provide a viable placement alternative for dredge material and restore critical habitat within the region.

4.2.3. Objectives of Action

The objective of this Section 1122 project is to beneficially use high quality sediment obtained by dredging the federal navigation channel to authorized depth and placing the material in the adjacent degraded marsh area known as Hawks Club. The project will be monitored pre-, during and post-construction to provide valuable scientific information in support of potential future beneficial uses of high quality dredge material.

Through the 1122 Program, the marsh restoration pilot project will be constructed as a one-time effort, with the goal of providing significant environmental, social, and economic benefits. will result from these efforts through an improved understanding of sediment pathways and optimization of future dredging and placement strategies. Future increments on the parcel may be implemented for future dredging cycles.

Overall pilot project objectives include:

- reduce storm damage to property and infrastructure;
- restore and create aquatic ecosystem habitats;
- support risk management adaptation strategies; and

reduce the costs of dredging and dredged material placement or disposal, such as for projects that use dredged material as construction or fill material, civic improvement objectives, and other innovative uses and placement alternatives that produce public economic or environmental benefits.

Project specific objectives include:

1. Improve the quantity and quality of emergent marsh habitat important to migratory and resident waterfowl.
2. Improve the resiliency of existing and restored marsh by reducing wind and wave driven erosion.
3. Increase the available placement areas to facilitate maintenance dredging opportunities along Sabine River.
4. Demonstrate the viability of BU of dredge material for restoration of coastal landforms and habitat.

4.2.4. Study Opportunities

This pilot project provides the opportunity to demonstrate regional sediment management principles through beneficially using dredge material to restore an eroded coastal habitat by placing additional sediment in the parcel and restoring an elevation and condition that supports marsh plants. The PDT incorporated lessons learned, partnerships, and monitoring data for recently constructed projects in coastal Texas federal navigation channels within SWG. Specific project objectives include:

- Use an RSM approach to keep dredged sediment in the natural system.
- Improve recreational opportunities by restoring degraded marshland, protecting habitat for wildlife viewing, and promoting safe and reliable navigation channels.
- Reduce dredging and dredged material placement costs by combining dredge mobilizations, leveraging funds and objectives across business lines and promoting beneficial use to build natural infrastructure.
- Establish trust with stakeholder groups/natural resource agencies through coordination of the 1122 project alternatives.

- Use design lessons learned and monitoring results to understand best practices for marsh restoration

4.3. Planning Constraints

Planning constraints relevant to the study include natural resources limitations such as limits on sediments for restoration; environmental impacts of human activities in the Study Area; infrastructure and cultural resources that must be avoided or relocated; and limitations in the characterization and simulation of environmental processes that determine the effects of alternatives plans. Additionally, barrier shoreline systems are dynamic. Each hurricane and winter season will impact the shoreline to varying degrees. The Study focused on the following key constraints:

- Avoid adverse impacts to surrounding coastal areas and threatened and endangered species. (Alternatives developed should not adversely impact the surrounding ecosystems. Additionally, these plans should not adversely impact threatened and endangered species such as the piping plover.)
- Avoid impacts to infrastructure and cultural resources.
- Operations and maintenance funding requirements
- Natural resources limitations. The limited availability of natural resources such as suitable sand materials is a critical constraint.

4.4. Management Measures Considered and Screened

Management measures were developed to address Study Area problems and to capitalize upon the Study Area opportunities. A management measure is a feature or an activity that can be implemented at a specific geographic site, called the project area, to address one or more planning objectives. A management measure can be combined with other manage. Alternative development is a complex, iterative process which refines features and combinations as additional detail becomes available.

Due to the specific description of the measures within the proposal selected for the pilot study, the primary management measure considered was beneficial use of dredged material from the Sabine River, shown in Figure 12, for marsh restoration, with supporting features to increase sustainability and reduce the areas problems in the Study Area. In addition to the base disposal plan (disposal at PAs 29A and 29B) only the Hickory Cove Marsh site was considered for this Study.

The range of alternatives considered here and assessed in the EA include the no action alternative, which is dredging and disposal of dredged material using the “Federal Standard” (current practice), and various approaches to the proposed pilot project (recommended plan or beneficial use project).

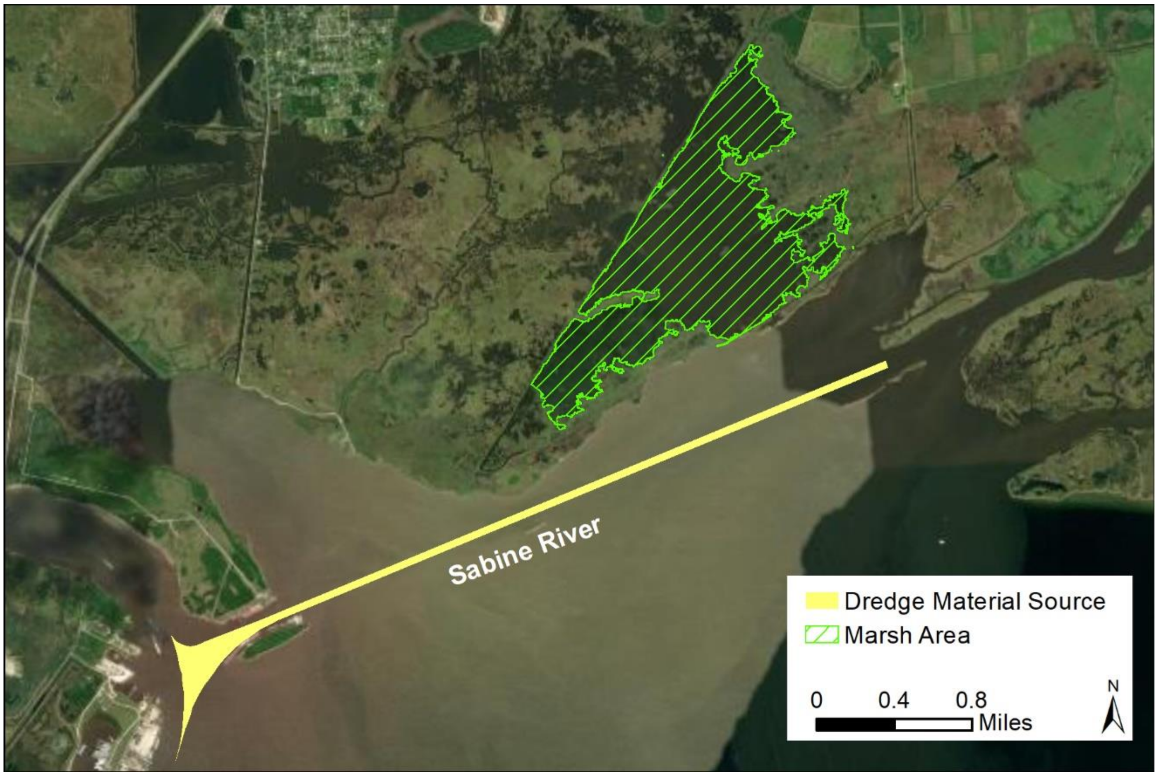

Figure 12. Dredge material source, Sabine River channel segment

4.4.1. Emergent Marsh Restoration

Emergent, coastal marsh is essential habitat for both terrestrial and aquatic species and stabilizes shorelines, reduces the impacts of climate change (such as sea level rise) on coastal habitats and communities. Target elevations for the marsh were established based on successful vegetation establishment at the Old River Cove restoration site in the adjacent Lower Neches Wildlife Management Area adjacent to Hickory Cove, managed by the Texas Parks and Wildlife Department (TPWD). Marsh restoration meets the study objectives to improve the quantity and quality of emergent marsh habitat important to migratory and resident waterfowl, increase the available placement areas to facilitate maintenance dredging opportunities along Sabine River, and demonstrate the viability of BU of dredge material for restoration of coastal landforms and habitat.

The assumptions and design considerations for marsh nourishment were based on resource agency input. The elements of the marsh restoration are noted below:

- Sediment will fill approximately 60% of the marsh to 1.2 ft. and 40% of the marsh to approximately 0.5 ft. to mimic successful marsh conditions,
- An existing containment dike will be restored with material from the marsh interior to limit tidal influence and salinity intrusion to the marsh;
- Training berms will be constructed from in-situ material during nourishment;
- The sediment source for marsh creation is assumed to be from the Sabine River, , depending on dredge cycle timing and available quantities; and

- Plantings will be provided by TPWD consistent with the adjacent Old River Cove reference site.

4.4.2. Breakwater

A breakwater is a common measure constructed to complement marsh restoration by interrupting the erosion due to wind waves, navigation traffic, climate change and increased salinity that destabilizes sensitive vegetation and shorelines. CESWG includes breakwaters in all placement area designs and restoration efforts along the coast. DU, similarly, has extensive experience in coastal restoration efforts along the Texas coast and waterways, and provided the breakwater design as part of the initial pilot project proposal.

Hickory Cove's shoreline runs parallel to the Sabine River/GIWW on the northern side of Sabine Lake and is exposed to wave action that has repeatedly degraded the containment dike on the exterior of the marsh. The addition of a breakwater will support the restoration effort and will perform over a longer duration than the containment dike can. A repaired containment dike will be vulnerable to coastal forces and insufficient to prevent marsh degradation over time. Attenuating waves was considered necessary to mitigate marsh degradation exacerbated by these conditions

Inclusion of a breakwater meets the study objectives to improve the resiliency of existing and restored marsh by reducing wind and wave driven erosion and increase the available placement areas to facilitate maintenance dredging opportunities along Sabine River.

Attenuating waves was considered necessary to mitigate marsh degradation exacerbated by these conditions. The preliminary design of this feature is shown in Figure 13. Key assumptions and design considerations for the breakwater are noted below:

- Breakwater would be placed sufficiently offset from the boundaries of the Sabine River navigation channel to allow for safe navigation;
- Breakwater would be placed approximately at the -3 feet contour up to a crest elevation of +3.5 feet; and
- Openings would be required at access points required for fisheries access or circulation (to be determined in Design and Implementation phase).

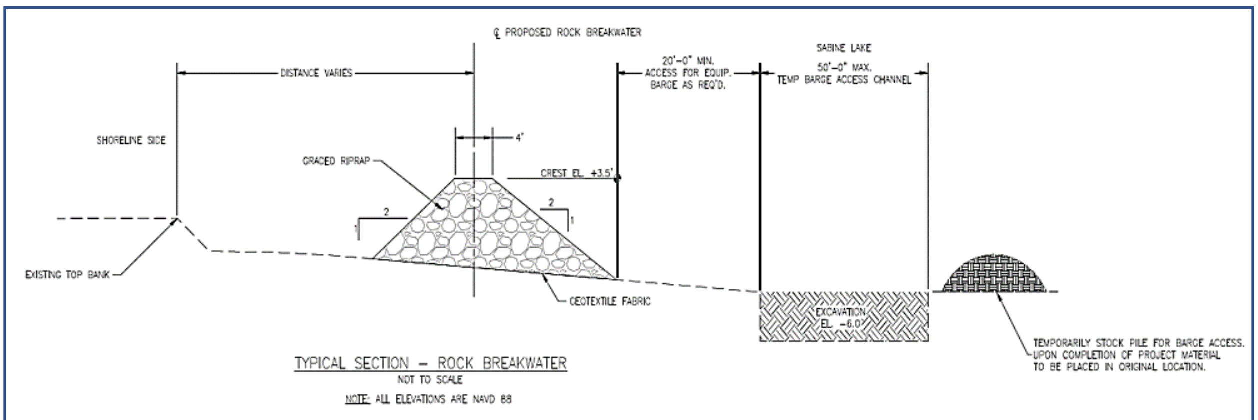

Figure 13 -Typical Breakwater Section for Hickory Cove (Ducks Unlimited, 2018b)

4.4.3. Living Shoreline

A living shoreline is a third measure to further stabilize the shoreline, regain habitat by promoting sediment accretion and achieve more study objectives. Dredge material will be placed between the containment dike and the breakwater and it will be planted. Unlike the interior marsh area that will be planted with freshwater marsh vegetation, the exterior of the containment dike will be planted with salinity tolerant vegetation as it will be exposed to the Sabine Lake estuary. Inclusion of a living shoreline meets the study objectives to improve the quantity and quality of emergent marsh habitat important to migratory and resident waterfowl, increase the available placement areas to facilitate maintenance dredging opportunities along Sabine River, and demonstrate the viability of BU of dredge material for restoration of coastal landforms and habitat.

4.4.4. Screening of Measures

Measures were screened based planning constraints; support for objectives; measure effectiveness; and efficiency. Based on the constraints and due to the dynamic coastal processes in the Study Area, all three measures were retained for consideration in project alternatives. Table 8 presents a qualitative comparison of the relative achievement of study objectives. The basis for the assessment is as follows:

Meet - The minimum requirement for the objective is met with the proposed measure but more opportunities remain unimproved

Satisfactorily meets – More than just the minimum requirements for meeting the objective but could better perform in some areas

Best meets - Meets all requirements to the maximum with additional, incidental benefits across different mission areas.

Table 8. Relative achievement of study objectives

Minimally meets: X; Satisfactory: XX; Best: XXX			
Objective	Marsh Restoration	Breakwater	Living Shoreline
Improve the quantity and quality of emergent marsh habitat important to migratory and resident waterfowl	XXX	X	XX

Improve the resiliency of existing and restored marsh by reducing wind and wave driven erosion.	X	XXX	XX
Increase the available placement areas to facilitate maintenance dredging opportunities along Sabine River.	XX	X	X
Reduce shoaling and sources of sediment accumulation to lessen maintenance dredging needs along Sabine River.		XXX	

4.5. Alternatives Analysis

Alternatives were formed by assembling the measures in an incremental manner. Marsh restoration is the primary components of each alternative, with other measures added to create an array.

In addition to the base disposal plan (disposal at PAs 29A and 29B) only the Hickory Cove Marsh site was considered for this Study.

The range of alternatives considered here and assessed in the EA include the no action alternative, which is dredging and disposal of dredged material using the "Federal Standard" (current practice), and various approaches to the proposed pilot project (recommended plan or beneficial use project).

The No Action Plan and the Hickory Cove Marsh Placement alternative plans are described below:

No Action– Maintenance dredging within the Sabine River section of the SNWW navigation channel occurs infrequently due to the lack of available placement areas and need. The base navigation plan for this reach of the SNWW is not formally established by a Dredged Material Management Plan. For the purposes of comparison, the placement areas 29A and 29B, which used during the most recent emergency dredging of this section of the SNWW, was considered the Base Plan. Site improvements would be required for PAs 29A and 29 B, to create capacity for placement of dredged material. Further detail is provided in Appendix F, Base Plan Improvement Summary.

Alternatives were formed by assembling the measures in an incremental manner. Marsh restoration is the primary components of each alternative, with other measures added to create an array. The No Action Plan and the Hickory Cove Marsh Placement alternative plans are described below:

Table 9. Measures within each alternative

Alternative	Marsh Restoration	Breakwater	Living Shoreline
No Action			

Alternatives 1a-1c	X		
Alternative 2	X	X	
Alternative 3	X	X	X

The alternatives were created as Hickory Cove Marsh Placement with a series of incremental measures to reduce exposure to coastal forces and enhance sustainability of the marsh:

Alternative 1: Restoring marsh to a target elevation for vegetation establishment utilizing dredged material on three potential scales based on estimated volumes (Figure 12). This alternative would restore an existing containment dike and restore marsh habitat. It does not include a breakwater or living shoreline. Since the actual sediment volume may vary by the time of construction, the uncertainty was addressed in formulation by considering different scales of marsh restoration as Alternatives 1a, 1b and 1c, to include 500,000, 900,000 and 1,300,000 cy or 68, 126 and 190 acres of marsh respectively.

Figure 14: Alternative 1 a-c

Alternative 2: This alternative builds upon Alternative 1 by including a detached breakwater to armor the shoreline along the Sabine River to reduce erosion of sediment and ensure sustainability of the marsh (Figure 15). The proposed breakwater is approximately 14,623 linear feet.

Figure 15: Alternative 2

Alternative 3: Alternative 3 adds a living shoreline to Alternative 2 to provide a comprehensive solution that would include marsh restoration, breakwater shore protection, and a living shoreline, which includes additional sediment and vegetation between the containment dike and the breakwater to produce additional habitat. (Figure 16).

For the purposes of this Decision Document, alternatives and their associated costs were developed and compared to the cost of the Federal Standard (current dredging and placement practices) for environmental assessment. While the current practice is the Federal Standard, which does not meet the purpose and need of the WRDA Section 1122 and the Pilot Project.

Placement at Hickory Cove Marsh was qualitatively compared to marsh restoration at an adjacent site known as Bessie Heights to confirm the viability of the pilot study parcel to achieve ecological lift. The sites were shown to provide comparable conditions and the Hickory Cove site is expected to provide more unique habitat. Alternative sites were not explored further.

Marsh restoration and containment dike repair was considered as the initial project alternative, and two additional alternatives were developed by adding features to sustain the marsh restoration over time.

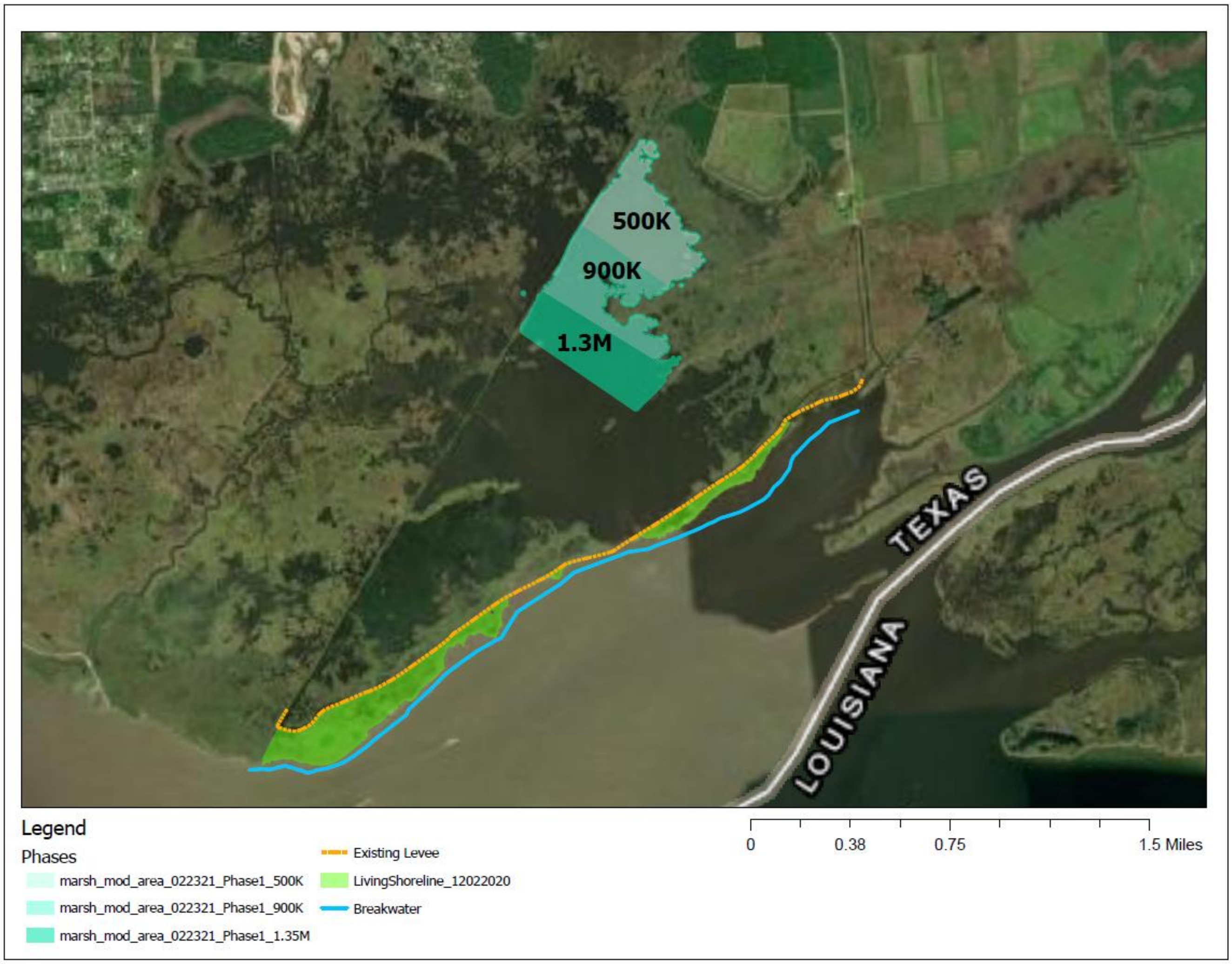

Figure 16: Alternative 3

While not included in the above alternatives, the study also identified two additional increments of marsh modification and restoration that could be completed at a later date, should dredged material become available. The second increment would restore an additional 260 acres of marsh, with the third increment restoring the final 157 acres of marsh. This was proposed to facilitate continued dredging and marsh restoration opportunities into the future, and to encourage additional BU over time.

Figure 17 - Future Increments of Marsh Restoration

4.6 Quantifying Ecological Lift

Ecological lift, or the environmental benefits expected to be achieved through the restoration effort are quantified to assess relative cost effectiveness of each alternative.

An Interagency Team comprised of State and Federal resource agencies was convened to support the restoration planning and to the ecological modeling strategies to assess performance. The team agreed that Habitat Evaluation Procedures (HEP) modeling using an USACE-certified species' model would be the best approach for the study and considered several USACE-certified species' models based on the range of each modeled species, existing and future cover types, and specific habitat requirements. HEP is essentially an ecological valuation technique that uses both quantitative and subjective valuations or weighting of environmental variables to arrive at an overall rating of a site as habitat for a target species (i.e. the quality of an area as wildlife habitat can be evaluated vis-à-vis life-cycle requirements of a species of interest). For this study, the mottled duck (*Anus fulvigula*) was selected as the target species because of their historic presence in the emergent wetlands (freshwater, brackish and salt marshes) of the action area. Additionally, targeted habitat management and restoration by public land managers and conservation organizations has been ongoing as a means to contribute to the recovery of the species (communications with TPWD, DU, and the Gulf Coast Joint Venture).

HEP are formal procedures established by the US Fish and Wildlife Service (USFWS) that assumes the quality of an area as wildlife habitat can be described by a single number, the Habitat Suitability Index (HSI). The HSI ranges from 0.0 to 1.0, with 1.0 representing optimum habitat. Each model has abiotic and biotic variables that are required to support the target species. Based on field collected data (for existing condition) and predicted future changes to the variable (future without project and future with project conditions), the model user can numerically describe, though the Suitability Index, the habitat quality of an area for any variable value. After a Suitability Index has been developed, a mathematical formula that combines all Suitability Indices into a single HSI value is constructed.

HSI scores were generated for each alternative using certified species-specific spreadsheet calculators. The HSI scores were then multiplied by the acreages to calculate the Habitat Units (HUs). HUs represent a numerical combination of quality (i.e. Habitat Suitability Index) and quantity (acres) existing at any given point in time.

HUs represent a single point in time; however, the impacts of any of the alternatives would occur over the entire planning horizon (50 years). To account for the value of change over time, when HSI scores are not available for each year of analysis, the cumulative HUs are calculated using a formula that requires only the target year (TY) and the area estimates (USFWS 1980) and are then annualized over the 50-year period of analysis to arrive at an Average Annual Habitat Unit (AAHU) that is predicted to be provided by the alternative (**Error! Reference source not found.**).

Table 10 - Estimated Ecological Lift in AAHUs

Alternative	AAHUs					
	Dike Repair W/O Breakwater	Dike Repair W/ Breakwater	BU W/O Breakwater	BU W/ Breakwater	Living Shoreline	Total
1a (68 acres BU)	61.1	_	9.4	_	_	70.5
1b (126 acres BU)	61.1	_	17.4	_	_	78.5
1c (190 acres BU)	61.1	_	26.2	_	_	87.3
2 (190 acres BU)	_	147.2	_	109.4	_	256.4
3 (190 acres BU)	_	147.2	_	109.4	35.1	291.5

5.0 Real Estate Requirements

The NFS does not have any real estate interests in the project vicinity. Real estate requirements for project implementation were assessed for the alternatives under consideration, and the real estate costs and associated implementation risks were considered in the alternative evaluation. Detailed Real Estate summary information is provided within Appendix C, the Real Estate Plan.

The real estate requirements to implement the largest of the beneficial use alternative include the acquisition of a fixed-term easement for over approximately 337 acres, impacting 6 tracts and one private landowner. Specific pipeline routes to move dredged material have not yet been identified but are assumed to be submerged and not impacting any additional upland parcels. The approximately 14,623 linear foot breakwater would be constructed exclusively upon approximately 2 acres of submerged lands, therefore navigation servitude will be exercised and no acquisition will be required for this aspect of the project. The real estate requirements outlined in 10 below represent the widest possible footprint for consideration and are expected to be refined during the next phase of the project. This section of the REP will be updated as more information is available.

5.1. Breakwater

The entirety of the breakwater footprint is on submerged lands, adjacent to the Sabine River (Figure 18). The breakwater feature is approximately 14,623 linear feet. At its widest point beneath the water at the -3' contour, the breakwater is estimated to be 30' in width. At the crest elevation of +3.5' above the water, the breakwater is estimated to be 4' in width, with an anticipated slope of 2:1. The total footprint of the feature is approximately 10 acres.

While the Texas GLO manages all submerged lands 10.35 miles out into the Gulf of Mexico, the Federal Government is able to exercise navigation servitude to construct this aspect of the project. Therefore, there are no real estate requirements to construct the breakwater.

It is possible that a third party, Ducks Unlimited (DU), may construct the breakwater. Should DU implement the breakwater feature at the same or a later date through grant funding, the private organization would need to seek a lease from the Texas GLO to support construction and any continued O & M.

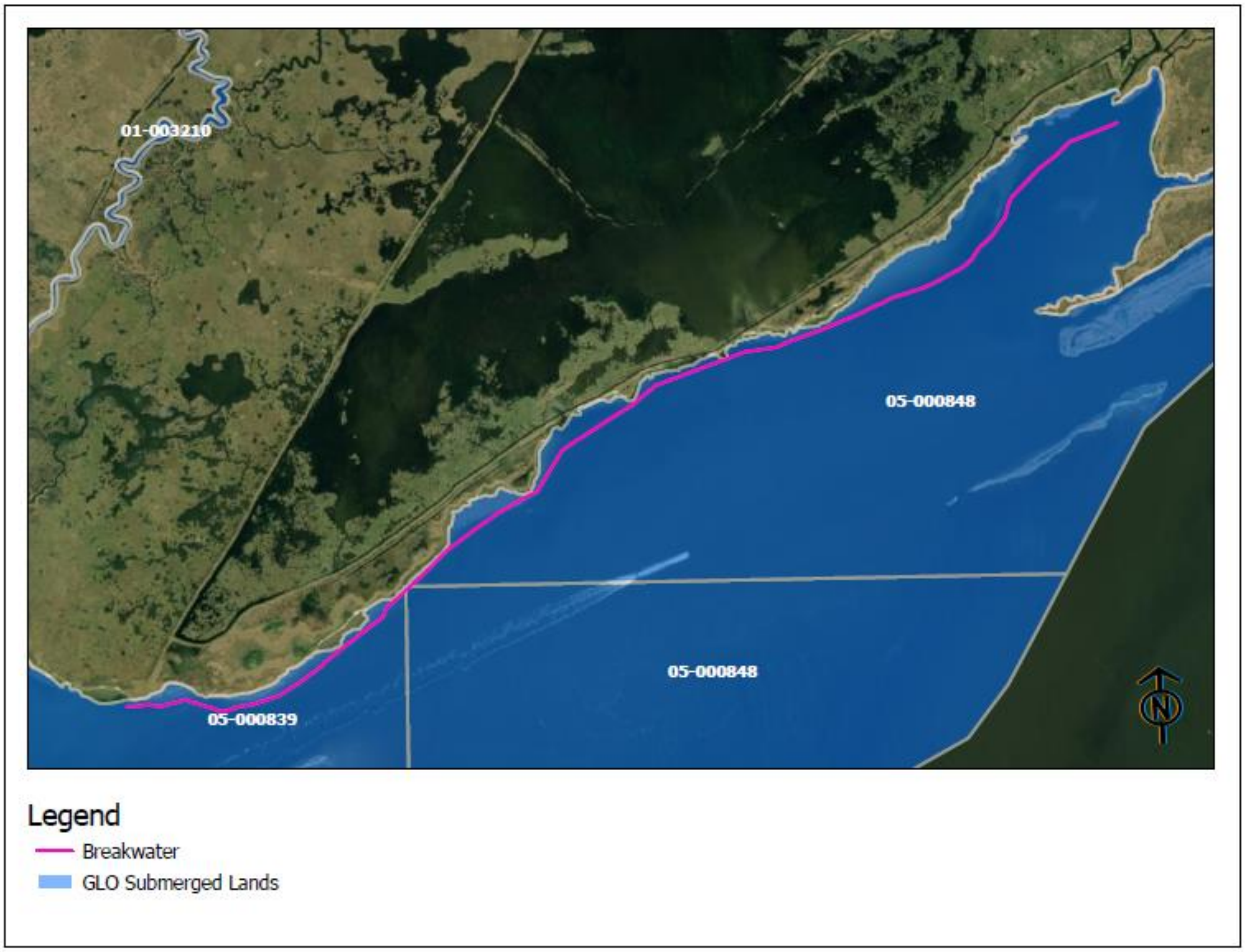

Figure 18: Breakwater Footprint

Table 11: New Real Estate Requirements for Alternative 3

Parcel ID	Total Tract Acres (per Orange County Appraisal District)	Acres Needed for 1.3 MCY Marsh Modification	Acres Needed for Existing Dike Repair	Acres Needed for Landside Access	Acres Needed for Breakwater	Acres Needed for Living Shore-line	Total Acreage (% of Total Tract)
R25748	474	76	N/A	4	N/A	N/A	80 (16.9%)
R16179	381	114	N/A	6	N/A	N/A	120 (31.5%)
R23869	105	N/A	.73	10	N/A	17	27.73 (26.4%)
R20762	716.7	N/A	.63	28	N/A	4	32.63 (4.6%)
R23002	117.8	N/A	.65	N/A	N/A	5	5.65 (4.8%)
R18038	331	N/A	1.26	N/A	N/A	70	71.26 (21.5%)
Submerged Lands	N/A	N/A	N/A	N/A	10	N/A	N/A

5.2. Additional Increments

Should additional dredged material become available for the project, the real estate requirements for marsh modification phases 2 and 3 would include the acquisition of an additional 260 acres and 157 acres, respectively. Table 12 below outlines the anticipated new real estate requirements to construct the entire scoped project.

It is assumed that no access and/or staging areas beyond the limits of the project footprint will be required. This will be confirmed during the DI phase. At the conclusion of the DI phase, when the project reaches 95% design, determinations can be finalized and the REP will be updated to include this information, as well as the duration for any temporary work area easements (Standard Estate #15), if determined to be necessary.

There is no mitigation required for this project, and therefore no real estate requirements for mitigation components.

5.3. Estates

The NFS is responsible for securing and maintaining the minimum real estate interests required for the project. Construction of the complete project, including the breakwater and living shoreline, may require a variety of real estate interests as outlined below and in Table 12.

For the emergent and submerged lands on the privately-owned parcels, the CESWG Real Estate Division (CESWG-RE) is proposing the use of a non-standard, fixed-term ecosystem restoration easement to cover the placement of dredged material, planting activities, and pipeline placement to move dredged material.

As stated in earlier, navigation servitude will be exercised to construct the breakwater feature.

Should any access/staging areas be identified outside of the limits of the project footprint, standard estate #15, Temporary Work Area Easement would apply. This easement is outlined in Section 5.3.1 below.

Table 12: Estates Required

Project Feature	Estates
Dredged Material Placement, Plantings of Native Species, Living Shoreline, Pipeline for Dredged Material, Dike Repairs on Emergent and Submerged Lands within Privately-Owned Parcels	Non-Standard Estate: Fixed-Term Ecosystem Restoration Easement
Breakwater within Submerged Lands	N/A – Navigation Servitude
Access/Staging Areas	Standard Estate #15 – Temporary Work Area Easement

5.3.1. Non-Standard Estate for Private Lands

CESWG-RE acknowledges that it is USACE policy to acquire fee simple title for ecosystem restoration projects, as fee interest ensures complete and permanent control over future use of lands and fully protects the interest of the Government. However, USACE regulations also indicate that a lesser interest, such as a specific type of easement, may be appropriate depending on the operational requirements of the project and other circumstances relevant to project implementation, including landowner preference (EP 1165-2-502, Paragraph 17b. and ER 405-1-12-9, Paragraph a(6)). CESWG-RE proposes the acquisition of a Non-Standard Fixed Term Ecosystem Restoration Easement in lieu of fee for this pilot program Project.

This project involves the beneficial use placement of dredged material sourced from the Sabine River. The life of the project, for period of analysis purposes, is considered to be 50 years. A timeline for work on the tracts cannot be developed at this time, as the waterways targeted for material are not regularly dredged and are not on the schedule for work plan funding per the Operations Division.

Once the dredged material is placed and final plantings are completed, activities on the project lands will cease. No future O & M (O&M) is planned for the project. Environmental monitoring will continue for 10 years as required by Section 1161 of WRDA 2016. The project is expected to be self-sustaining. Therefore, it is the opinion of the PDT that acquisition of fee title is not necessary to accomplish the construction and operation and maintenance of the project, and that those requirements can be accomplished through the acquisition of a fixed-term ecosystem restoration easement which clearly defines the rights needed for the project and which sustains the Federal investment. The non-standard estate will propose termination of the fixed-term easement at 10 years post-construction or upon the Project's deauthorization.

At the time of this report, the non-standard estate is continuing to be refined at the District and is expected to be routed by separate request to USACE Headquarters (HQUSACE). Real estate has worked closely with the NFS on drafting the non-standard estate. Additionally, the NFS has engaged the landowner in discussions to ensure the language presented for approval to HQUSACE will be acceptable to the landowner upon project implementation. The latest draft of the granting clause appears below.

DRAFT Non-Standard Estate: Fixed Term Ecosystem Restoration Easement

An assignable right, servitude, and ecosystem restoration easement in, on, over and across the lands of the Grantors described in Exhibit A [Tract Nos. ____, ______, _____], attached hereto, for a period not to exceed ten (10) years to construct, operate, maintain, repair, alter, rehabilitate, remove, replace and monitor features of the HICKORY COVE MARSH RESTORATION & LIVING SHORELINE PROJECT, BRIDGE CITY, TX. In the event the Project is de-authorized by the federal government, this Easement and all rights granted hereunder shall terminate.

The Grantee shall have the right to construct, operate, maintain, repair, replace, rehabilitate, monitor, and adaptively manage the Project on the Property, which rights shall include the right to: (a) excavate and deposit dredged material, sediment, and/or other beneficial materials on the Property; (b) accomplish any alterations or contours on the Property to accommodate the materials deposited on the Property in connection with the Project and to perform necessary work for the prevention or remediation of damages to marsh, wetlands, habitat restoration, or other natural values; (c) install, construct, store, alter, maintain, repair, replace, relocate, and remove dikes, berms, fencing, monitoring devices, equipment, supplies, materials, warning or informational signs, notices, markers and other similar items related to the Project; (d) conduct surveys, borings, inspections, investigations, monitoring, adaptive management practices, and similar activities to evaluate the effectiveness of the Project, and/or to enhance, extend, periodically replenish and maintain the material deposited or placed on the Property, and/or to determine if the Grantor, or its successors, heirs, and assigns are complying with the covenants and prohibitions contained in this Easement; (e) plant, cause the growth of, nourish, replenish, manage, and maintain vegetation and control or remove invasive species; together with the right to remove structures or obstructions including dikes; reserving, however, to the owners, their heirs and assigns, all other rights and privileges that may be used without interfering with or abridging the enumerated rights and easement hereby conveyed and acquired; all subject to existing easements for public roads and highways, public utilities, railroads and pipelines.

At the request of the landowner, it is expected the final easement will also include language requiring notification prior to work and language expressing that, if at all possible, work will avoid the months of November through February to minimize disturbance to wintering waterfowl. These requests were reviewed and approved by the PDT. The Operations Division concurred and added that the timing of funding, as well as the District's ability to dictate Order of Work, could likely accommodate the request with minimal disturbance during the month of November.

At the time of this report, the project's DI schedule aims for real estate certification in February 2023. Timely approval of a non-standard estate stipulating less than fee interest is an implementation risk to the project. Without approval, the lands required for the construction of the project will not be acquired.

6.0 Alternative Cost Estimates

Cost estimates for the range of alternatives were developed to support screening of alternatives for cost effectiveness. The cost estimate considered recent experience with similar projects, quantity estimates for features as designed, and real estate needs for access, construction and labor. A contingency is included to reflect potential cost risk for construction at a future point in time. Since the project is proposed as beneficial use of dredge material, the some or all of the dredging cost is expected to be borne by O & M funds of the SNWW. Since the Section 1122 pilot study allows for cost share of dredging in excess of the federally justified depth, the dredging costs will vary in scale, and therefore it is included in the alternative costs and will vary depending upon dredging depth decisions and O&M budgeting. Alternatives 1a, 1b and 1c were scoped to address potential variability in the ultimate dredging dept, and the dredging costs grow as the proposed dredging depth deepens from 26 feet for Alternative 1a through 31' plus 2' over depth in Alternative 1c. Table 13 presents the alternative cost estimates.

Section 1122 authorizes incremental cost of delivery of sediment to the BU site instead of the base plan disposal at 100% federal cost. Since there is no DMMP in effect, the base plan was identified as the most recent, and therefore most likely future placement site for dredge material in the absence of a BU effort. The most recent dredging of the SNWW was an emergency action in 2012 and used PAs 29A and 29 B for material disposal. The establish the incremental cost, the PDT assessed the cost of disposal from this dredge cycle at PAs 29 A/B. Geotechnical analysis determined that improvements would be required to prepare PAs 29 A/B to receive a comparable volume of dredge material from the Sabine River. The site improvements would include site preparation, construction of approximately 756,000 linear feet of dike lift and a replacement spillbox. Comparison of the cost of the FWOP/Baseline condition to the Hickory Cove Marsh placement alternatives demonstrated that placement at Hickory Cove Marsh is the lowest cost alternative and accordingly, Hickory Cove Marsh was designated to be the Federal

Standard. Table 13 presents the relative cost of site upgrades and preparation and placement at PAs 29 A/B.

Table 13 – Preliminary Cost Estimate of Alternatives, FY21

Code of Accounts	**Alt 1a 500,000 cy**	**Alt 1b 900,000 cy**	**Alt 1c 1.35 mcy**	**Alt 2 1.35 mcy & Breakwater**	**Alt 3 1.35 mcy, Living Shoreline & Breakwater**
NON-FEDERAL COSTS					
01 Lands and Da	71,695	93,145	106,152	106,152	162,027
Total Non-Fed	***71,695***	***93,145***	***106,152***	***106,152***	***162,027***
FEDERAL COSTS					
Lands and Dama	17,813	21,375	21,375	21,375	36,000
Marsh creation	1,516,200	2,116,600	2,150,000	2,150,000	2,150,000
Dredging	5,118,300	7,769,700	10,752,600	10,752,600	10,752,600
Living Shoreline	N/A	N/A	N/A	N/A	2,442,000
Breakwater	N/A	N/A	N/A	19,468,000	19,468,000
30 Planning, E&	729,795	1,087,493	1,419,286	3,560,766	3,829,386
31 Const Mngt	490,953	731,586	954,792	2,395,424	2,576,132
Total Fed	$ 7,873,061	$ 11,726,754	$ 15,298,053	$ 38,348,165	$ 41,254,118

Table 14 - Required Improvement of Placement Area Alternative, FY21

Component	Baseline/ FWOP 29 A/B 500,000cy	Baseline/ FWOP 29 A/B 1.3mcy
Site Preparation	3,400,000	22,981,000
Lands	80,000	178,655
Dredging	7,518,000	17,159,000
TOTAL	10,998,103	40,319,000

7.0 Economic Analysis of Alternatives

Ecological lift is quantified in non-monetary units, and cost effectiveness is evaluated for efficiency in terms of incremental cost. CE/ICA is conducted with the USACE approved model IWR Planning Suite. Preliminary consideration of CE/ICA, until the model can be run, suggests that Alternative 1 is cost effective and incrementally justified.

- The three alternatives increase in scale by adding a feature to the smaller alternative, and additional AAHUs are quantified as a result.
- The preliminary analysis indicates that all three are cost effective, meaning that no alternatives produce fewer AAHUs as a lower cost.
- Alt 3, which adds a breakwater and a living shoreline, is incrementally justified and a Best Buy Plan, demonstrated by application of the IWR Planning Suite.

7.1. Costs

Total project economic costs were annualized using the Annualizer Tool in Institute for Water Resources (IWR) Planning Suite II. A period of analysis of 50 years was used, along with a Federal Discount rate of 2.5% (per EGM 20-01 dated 31 October 2020). Cost estimates are expressed in October 2020 dollars/price-level. Table 15 provides a summary of total and annualized plan costs. Construction durations were estimated to be 12 months or fewer for all alternatives, thus negating the need for calculating interest during construction (IDC). Only construction first costs are used to calculate annual costs. No OMRR&R have been included with this analysis. Base year is assumed to be FY 2023, when dredging is proposed.

Table 15 - Summary of total and annualized plan costs

	Project First Cost	Real Estate	IDC	Economic Cost	Annual Investment Cost	Annual M&AM	Annual OMRRR	Total Annual Cost
HICKORY COVE MARSH								
ALT 1a 500K CY of Marsh Creation	$1,884,700	N/A	N/A	$1,884,700	$66,450	N/A	N/A	$66,450
ALT 1b 900K CY of Marsh Creation	$2,620,500	N/A	N/A	$2,620,500	$92,400	N/A	N/A	$92,400
ALT 1c 1.3M CY of Marsh Creation	$2,673,100	N/A	N/A	$2,673,100	$94,250	N/A	N/A	$94,250
ALT 2 1.3M CY of Marsh Creation + Breakwater	$25,723,200	N/A	N/A	$25,723,200	$906,950	N/A	N/A	$906,950
ALT 3—1.3M CY of Marsh Creation + Breakwater + Living Shoreline	$28,685,000	N/A	N/A	$28,685,000	$1,011,400	N/A	N/A	$1,011,400

7.2. Cost Effectiveness and Incremental Cost Analysis

To conduct the CE/ICA analysis, environmental restoration benefits (increase in with-project AAHUs) and annual costs were entered into IWR Planning Suite II. This resulted in 5 cost effective plans for each reach, shown in Table 16.

Cost effective plans are defined as the least expensive plan for a given set of benefits, or environmental output. In other words, no other plan would provide the same or more benefits for a lower cost.

Table 16 - Annual Benefits and Annual Cost for Cost Effective Alternatives

	Alternatives	AAHU	Annual Cost ($1s) October 2020 Prices
Hickory Cove Marsh	ALT 1A—500K CY of Marsh Creation	70.5	$66,450
	ALT 1B—900K CY of Marsh Creation	78.5	$92,400
	ALT 1C—1.3M CY of Marsh Creation	87.3	$94,250
	ALT 2—1.3M CY of Marsh Creation + Breakwater	256.4	$906,950
	ALT 3—1.3M CY of Marsh Creation + Breakwater + Living Shoreline	291.5	$1,011,400

7.2.1. Cost Effective Plans

Note that cost effective plans (red triangles) include those identified as “Best Buy” plans (green squares) (Figure 19), which will be discussed in the next section.

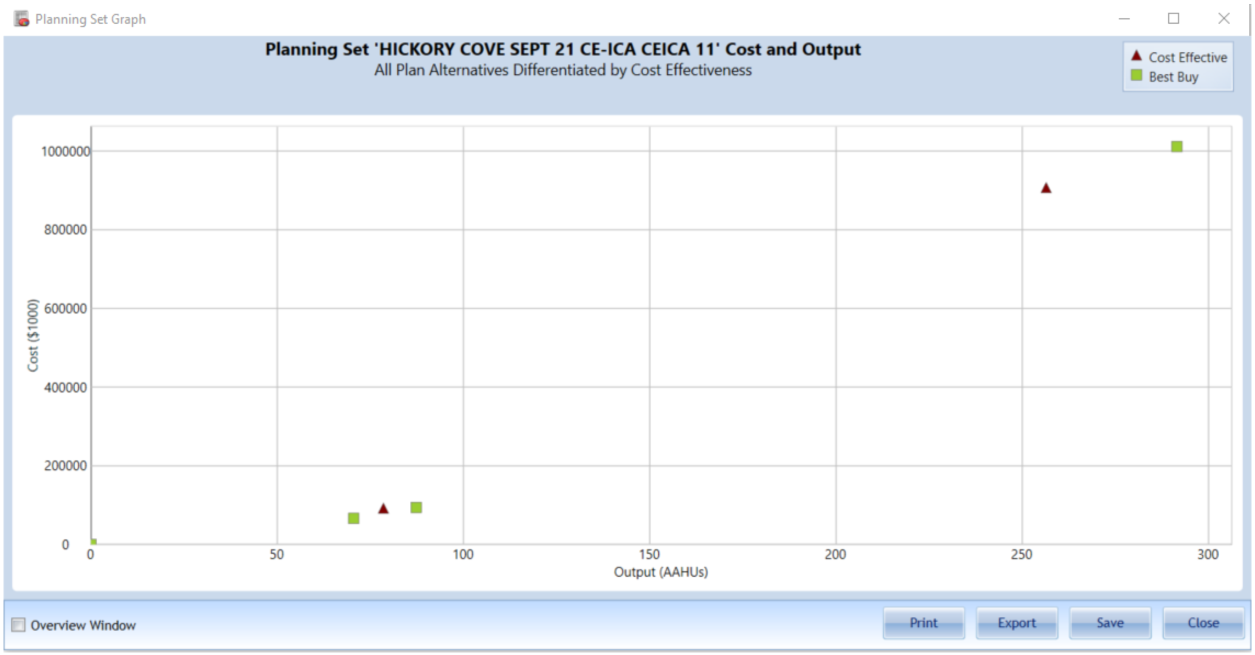

Figure 19. Cost Effective Results

Table 17 - Cost-Effective Plans

Cost Effective Plans	Plan Description	AAHUs	Annualized Cost ($1s)	Annualized Cost/AAHUs ($1)
No Action Plan	No Action Plan	0	$0	0
ALT 1A—500K Marsh Creation		70.5	$66,450	$943
ALT 1B—900K Marsh Creation		78.5	$92,400	$1,177
ALT 1C—1.3M Marsh Creation		87.3	$94,250	$1,080
ALT 2—1.3M MC + Breakwater		256.4	$906,950	$3,537
ALT 3—1.3M MC + BW + Live Shoreline		291.5	$1,011,400	$3,470

7.2.2. Incremental Analysis and Best Buy Plans

The next step in the CE/ICA analysis is to perform an incremental cost analysis (ICA) on the cost-effective plans. ICA compares the incremental cost per incremental benefit (output or lift in environmental output) among the plans to identify plans that maximize the last dollar spent. Starting with the no action plan, the incremental cost per incremental benefit is calculated from the no action for each cost-effective plan. The plan with the least incremental cost per incremental output is identified as the first of the “with-project” best buy plans. Then starting with that plan, the incremental cost per incremental benefit is calculated between that plan and each remaining cost-effective plan, and the one with the least incremental cost per incremental benefit is identified as the next plan in the array of best buy plans. This process continues until there are there are no remaining plans. The last plan in the best buy array, is typically the “kitchen sink” plan, or the plan that contains all of the management measures being analyzed.

From the cost-effective alternatives, four were identified as “Best Buy” plans (including the No Action plan). The results of the analysis are shown graphically in Figure 20 above.

The alternative Best Buy plans are:

Plan 1: No Action

Plan 2: ALT 1A—500k-c.y. Marsh Creation

Plan 3: ALT 1C—1.3M-c.y. Marsh Creation

Plan 4: ALT 3—1.3M-c.y. Marsh Creation + Breakwater + Living Shoreline

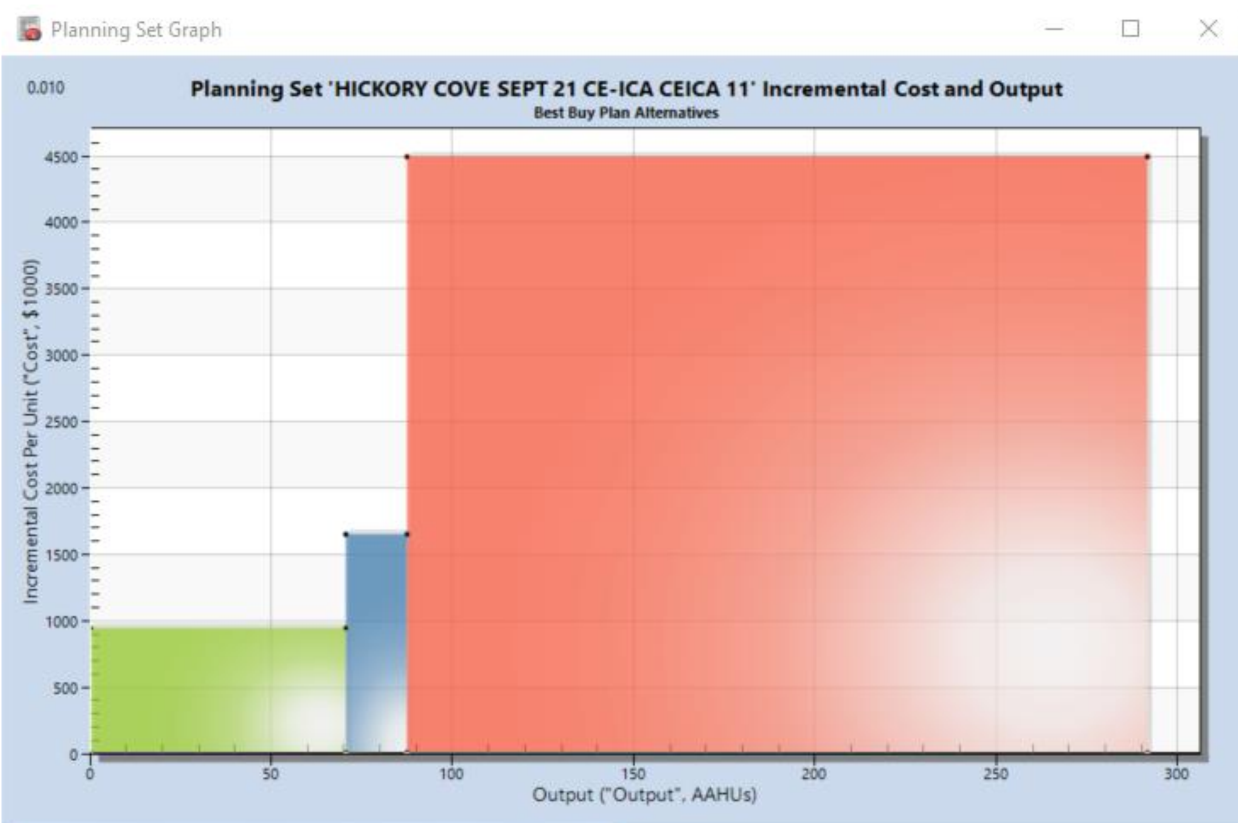

Figure 20 - Incremental Cost Analysis Result

Table 18 - Best Buy Plans

Plan	Outputs/ AAHUs	Total Annualized Cost ($1s)	Total Annualized Cost/AAHUs	Incremental Ann. Cost ($1s)	Incremental AAHUs	Incremental Cost per AAHU	Plan First Costs
PLAN 1: NO ACTION	0	$0	0	0	0	0	$0
PLAN 2: ALT 1A—500k-c.y. Marsh Creation	70.5	$66,450	$943	$66,450	70.5	$943	$1,884,700
PLAN 3: ALT 1C—1.3M-c.y. Marsh Creation	87.3	$94,250	$1,080	$27,800	16.8	$1,655	$2,673,100
PLAN 4: ALT 3—1.3M-c.y. Marsh Creation + Breakwater + Living Shoreline	291.5	$1,011,400	$3,470	$917,150	204.2	$4,491	$28,685,000

7.3. Final Array of Alternatives: Is it Worth It Analysis

Further consideration of the potential alternatives requires assessment of the benefits of each alternative that may not be captured in the AAHUs quantified for each action. In the case of HCM, the AAHUs capture habitat benefits through the Mottled Duck HSI model. Each added measure provides additional benefits to the region and are evaluated to demonstrate whether the additional cost for each added element is worth the added expense. Table 19 briefly summarizes the multiple benefits of each added increment.

Table 19 - Is It Worth It Analysis Considerations

Alt	Δ AAHU	Δ Cost	Additional Benefits
Alt 1c Marsh	70.5	$1,655	• Increases habitat • Unique wetland • Nav benefit-creates a PA that makes O&M dredging feasible (limited PA in region)
Alt 3 Marsh Breakwater Living Shoreline	204.2	$917,200	• All the above plus • Creates additional habitat at very little incremental cost, • Adds diverse habitat along the coast • Supports the function of the breakwater • Supports the marsh growth over time by creating an outer extent to catch sediment from marsh • Allows beneficial placement of more volumes of dredge material sediment

No Action Plan: (0 AAHUs; $0 Ann Cost; $0 Incremental Cost; 0 Incremental AAHUs; $0 Increment Cost per AAHU; $0 Average Cost per AAHU).

Alternative 1a—500k-c.y. Marsh Creation: (70.5 AAHUs; $66.4k Ann Cost; $66.4k Incremental Cost; 70.5 Incremental AAHUs; $943 Increment Cost per AAHU; $943 Average Cost per AAHU).

Yes. This alternative increases habitat over the No Action Plan by creating a rather unique wetlands area. Additionally, this alternative provides navigational benefits by serving as a placement area for future O&M dredging; the area currently lacks adequate placement areas for dredge material.

Alternative 1c—1.3M-c.y. Marsh Creation: (87.3 AAHUs; $94.3k Ann Cost; $27.8k Incremental Cost; 16.8 Incremental AAHUs; $1,655 Increment Cost per AAHU; $1,080 Average Cost per AAHU).

Yes. This alternative provides all of the benefits of the previously described plan. Moreover, the additional amount of dredge material (approximately 800k-c.y. will sustain the created marsh for a longer time period by reducing erosion and subsequent sediment loss.

Alternative 3—1.3M-c.y. Marsh Creation + Breakwater + Living Shoreline: (291.5 AAHUs; $1.0M Ann Cost; $917.2k Incremental Cost; 204.2 Incremental AAHUs; $4,491 Increment Cost per AAHU; $3,470 Average Cost per AAHU).

Yes. This alternative adds the Living Shoreline, which provides an additional buffer from erosive coastal forces, increases the volume of sediment to be beneficially used, and creates additional habitat for a variety of species.

7.4. Tentatively Selected Plan (TSP) Determination

Alternative 3 is recommended as the TSP after evaluation of the alternatives' ability to meet the objectives of the project and the comparative performance of the plan in terms of ecological lift, sustainability of the measure over time, and cost effectiveness.

Alternative 3 proposes beneficially using dredged material to restore marsh habitats and create resiliency against sea level rise (SLR). It is assumed all sediment needs for implementation of Alternative 3 would come from material dredged from the Sabine River. The sediment needs would be met using existing operations and maintenance dredging and would not induce additional dredging beyond the Federal Standard. Even though there is not sufficient dredge material to complete all three phases of the marsh restoration and the living shorelines during the initial construction period, it is assumed that funding might be made available to complete Phase 2 and Phase 3 during subsequent O&M dredging operations. Because of this, this analysis assesses the impacts of completing all phases of marsh restoration, the living shoreline, and breakwater construction. The impacts during subsequent phases of marsh restoration would be identical to those described here and are not expected to incrementally contribute to long-term adverse impacts. Prior to each subsequent phase of construction, this NEPA analysis will be reviewed to confirm the existing condition and impacts analysis remain valid. If conditions have changed significantly or if the impacts are expected to be different than described here, supplemental NEPA documentation would need to be completed.

The plan formulation process developed a progression of three alternatives from marsh restoration alone and dike repair (Alternative 1), marsh restoration with dike repair and a breakwater (Alternative 2), and the largest, marsh restoration with dike repair, a breakwater and a living shoreline (Alternative 3). The largest alternative aligns with the project proposal that was evaluated by HQUSACE and forwarded to the district for action. Two sub-alternatives of Alternative 1 were scoped and evaluated in response to the uncertainty in sediment quantity that would be produced depending upon natural conditions in the area and the O&M decisions of the ultimate dredging depth in the next dredging cycle. Evaluation of smaller increments of marsh restoration (Alternatives 1a and 1b) were found to be viable refinements should the dredge volume be lower than proposed within the initial pilot project proposal approved by HQUSACE considered. Therefore, following an IPR with the VT and district leadership, it was agreed that the PDT should proceed with the assumption that the uncertainty will persist until the dredging cycle is complete. The Section 1122 authority provides that additional dredging for placement purposes only may be undertaken, if the NFS cost shares the difference in dredging cost. At this time, the NFS has expressed support for the largest increment of marsh restoration. Therefore, Alternative 1c was recognized by the VT and PDT as the appropriate scale to be evaluated in combination with the additional features in Alternatives 2 and 3.

Therefore, after consideration of the ecological lift, the sustainability of the effort, and the navigational opportunity to create an opportunity for placement of dredge material in proximity of the channel, the screening analysis confirmed that Alternative 3 most effectively achieves the study objectives. It is consistent with proven best practices of the USACE and conservation agency efforts and satisfies the objectives of Section 1122.

8.0 Environmental Consequences/Affected Environment

This chapter describes the probable effects or impacts of implementing the No Action/Future Without Project (FWOP) and the action alternative (i.e., the Future with Project condition or FWP). Effects can be either beneficial or adverse and are considered over a 50-year period of analysis (2023-2073).

The No Action Alternative is the most likely condition expected to occur over the 50-year planning horizon in the absence of the action alternative. In this case, the No Action Alternative means that dredged material would not be beneficially used to complete restoration activities in the project area. As described in Section 6.0, O & M dredging of the Sabine River would occur according to the Federal Standard and placement of material following guidance in associated DMMPs or decision documents. Placement into PA 29A/B would require a dike lift of approximately 756,000 linear feet and installation of new drop falls and a perimeter ditch.

The No Action Analysis includes a brief impact analysis of reasonably likely projects (e.g. projects funded for construction or for which a decision document is available but is awaiting funding) that are expected to modify the existing conditions of the project area. It is assumed that all other projects that are ongoing in the study area would continue as planned but would not directly affect the project area and are therefore not discussed in the No Action analysis.

The Action Alternative is the TSP (Alternative 3), which involves beneficially using dredged material to restore marsh habitats and create resiliency against SLR. It is assumed all sediment needs for implementation of Alternative 3 would come from material dredged from Sabine River. The sediment needs would be met using existing operations and maintenance dredging and would not induce additional dredging beyond the Federal Standard. Even though there is not sufficient dredge material to complete all three phases of the marsh restoration and the living shorelines during the initial construction period, it is assumed that funding would be available to complete Phase 2 and Phase 3 during subsequent O&M dredging operations. Because of this, this analysis assesses the impacts of completing all phases of marsh restoration, the living shoreline, and breakwater construction. The impacts during subsequent phases of marsh restoration would be identical to those described here and are not expected to incrementally contribute to long-term adverse impacts. Prior to each subsequent phase of construction, this NEPA analysis will be reviewed to confirm the existing condition and impacts analysis remain valid. If conditions have changed significantly or if the impacts are expected to be different than described here, supplemental NEPA documentation would need to be completed.

Unless otherwise indicated, the impacts of dredging material are assumed to be identical under the No Action and Alternative 3 and will not be discussed herein. The impacts of dredging material have been thoroughly described in the Final Feasibility Report for Sabine-Neches Waterway Channel Improvement Project Southeast Texas and Southwest Louisiana (USACE 2011) and is incorporated by reference. This analysis will focus on the transportation and placement of dredged material into the Federal Standard location (No Action) or into the marsh restoration and living shoreline sites, as well as construction of the breakwaters (Alternative 3).

When considering impacts, it was assumed that at a minimum best management practices (BMPs) identified throughout this chapter would apply during project construction. Assumed BMPs are based primarily on widely accepted industry, state and federal standards for construction activities. Examples include but are not limited to:

- Use of silt fencing to limit soil migration and water quality degradation;
- Refueling and maintenance of vehicles and equipment in designated areas to prevent accidental spills and potential contamination of water sources and the surrounding soils;
- Limiting idling of vehicles and equipment to reduce emissions;
- Limiting ground disturbance necessary for staging areas, access routes, pipeline routes, etc. to the smallest area necessary to safely operate during construction and restoring staging area and access routes to result in no permanent loss;
- Minimizing project equipment and vehicles transiting between the staging area and restoration site to the greatest extent practicable, including but not limited to using designated routes, confining vehicle access to the immediate needs of the project, and coordinating and sequencing work to minimize the frequency and density of vehicular traffic.

- Minimizing use of construction lighting at night and when in use, directing lighting toward the construction activity area and shielding from view outside of the project area to the maximum extent practicable.

If, for some reason, the BMPs are not implemented, the impacts of any of the action alternatives would only minimally increase from those described in this chapter. The increase in impacts would not be substantial enough to cause an adverse insignificant impact to become significant.

8.1. Air Quality

8.1.1. No Action/FWOP Condition

Under the No Action Alternative, air quality in the region is expected to continue attaining NAAQS even as standards become more stringent. SIP maintenance plan requirements and state and local policies involve reducing emissions over the long-term, which should positively contribute to the area continuing to meet NAAQS in the future.

Under the Federal Standard, transport of dredged material to the upland PAs 29A/B would result in direct, short term adverse impacts to ambient air quality from construction activities associated with dredging, transport, and placement of material into the site. Under the FWOP, dredged material would be transported through a 3-mile-long pipeline and require at least one booster pump which will emit additional emissions beyond those emitted from the dredging vessel and pumps for transport less than 3-miles. As well, the requires modifications, such as dike raising, that would result in construction emissions from operation of heavy equipment, support vehicles, and other mechanized equipment. The level of emissions is not anticipated to contribute to long-term degraded air quality in the BPA or contribute to the area not meeting NAAQS in the future.

8.1.2. Alternative 3

The action would have direct, short term adverse impacts to ambient air quality from construction activities; however, no long-term adverse or beneficial impacts from long-term operation and maintenance of the project due to no permanent emissions emitting structures being constructed. Short-term air emissions would be mobile in nature, temporary, and localized to the restoration area being worked at that time.

As compared to the Federal Standard alternative placement site (PA 29A/B), Alternative 3 would result in a shorter pipeline distance (about 1.0 mile less) that would not require an additional booster pump and therefore less emissions associated with transport of material to the placement site. Additionally, no PA29A/B modifications would be required.

At the placement site and during construction of breakwaters, operation of heavy equipment, support vehicles, vessels, and other motorized machinery for construction would result in combustion of fossil fuels and the release of volatile organic compounds (VOCs), nitrogen oxides (NOx), carbon monoxide (CO), ozone (O_3), sulfur dioxide (SO_2), and particulates (PM_{10} and $PM_{2.5}$). Additionally, fugitive dust emitted to the atmosphere by heavy equipment and support vehicles moving across unpaved, non-vegetated roadways or staging areas and wind blowing dust from disturbed areas and storage piles into the atmosphere could create a haze over the project area and increase ambient concentrations of particulate matter.

Construction emissions, including fugitive dust, would be short-term lasting only as long as it takes to complete each measure. In addition to BMPs already listed at the beginning of the chapter, the following BMPs would further reduce air quality impacts and should be incorporated when developing contract specifications: the use of heavy machinery should be fitted with approved muffling devices that reduce emissions; maintain and tune engines per manufacture's specifications to perform at EPA certification levels, prevent tampering, and conduct inspections to ensure these measures are followed; and consider alternative fuel and energy sources (e.g. natural gas, electricity, etc.) when and where appropriate. Using higher tier equipment can further reduce emissions and should be considered when possible; however, it is recognized that using this equipment may contribute to higher costs or limited availability of such equipment.

8.2. Climate

Climate impacts are analyzed from two perspectives: impact of implementing any of the action alternatives on climate and climate change and the impact of climate change on the performance of any of the action alternatives.

NEPA does not specify significance thresholds that may be used to evaluate the effects of a proposed action on global climate. The appropriate approach to evaluating a project's impact on global climate under NEPA is in a state of flux. Current guidance is to follow the Council on Environmental Quality (CEQ) guidance released in August 2016, which recommends 25,000 metric tons CO_2 equivalent ($MTCO_2e$) of direct emissions per year be used as a presumptive threshold for analysis and disclosure within NEPA documents. The guidance suggests that if a proposed action would result in direct emissions below this threshold, the emissions would not be relevant to and would not need to be discussed within a NEPA analysis.

At the state level, GHGs are a regulated pollutant under the PSD program when emissions exceed the thresholds set in 30 TAC 116.164(a)(1) or (a)(2). The threshold for new source emissions is: the project emissions are above the major source threshold for a regulated pollutant that is not GHGs and will emit or have the potential to emit 75,000 tons per year (tpy) or more CO_2e. Emissions of GHGs are regulated and require authorization only when the project emission increases are above this threshold. None of the alternatives would exceed any non-GHG thresholds and would emit far fewer tpy CO_2e that the regulated amount.

8.2.1. No Action

8.2.1.1. Construction Activities

Under the No Action, construction activities associated with modifying the existing placement areas would generate GHG emissions as a result of combustion of fossil fuels while operating on- and off-road mobile sources. The primary GHGs generated during construction are CO_2, CH_4, and N_2O. The other GHGs such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are typically associated with specific industrial sources and processes and would not be emitted during construction. After construction is complete, all GHG emissions would cease and the area would return to baseline conditions. There are no apparent carbon sequestration impacts that would result from implementation, thus the total direct and indirect impacts would be constrained to very small increases in GHG emissions to the atmosphere from operation of on- and off-road mobile sources.

In years in which construction activities are implemented, emissions would incrementally contribute to global emissions, but would not be of such magnitude as to make any direct correlation with climate change (i.e. emissions less than 25,000 CO_2e/year or 75,000 tpy).

CO_2 emissions are highly correlated to fuel use. Approximately 99 percent of the carbon in diesel fuel is emitted in the form of CO_2 (EPA 2005). EPA published a CO_2 emission factor of 10,084 grams per gallon (g/gal) or 10 kilograms per gallon (kg/gal) which provides the CO_2e value. To determine the gallons of fuel used to implement the Federal Standard, it was assumed that 10 percent of the construction costs are associated with fuel consumption. Based on the 10-year average, Walla Walla has determined that the average cost of diesel is $3 per gallon. Using these assumptions, the Federal Standard is expected to spend approximately $24.4 million[1] on construction which translates into 813,333 gallons of fuel used, 8,133,333 kg of CO_2e, and 8,967 tons CO_2e (8,137 MTCO_2e) for the entire construction period (30 months), which translates into about 299 tons per month (271 MTCO_2e per month) or 3,587 tpy CO2e (3,252 MTCO_2e per year). The yearly emission of CO_2e for the No Action would be below the thresholds identified by CEQ or as regulated by the state as significant.

8.2.1.2 Performance

Climate conditions in Texas will continue to change over the next 50 years just as they have over the last several centuries. Future conditions are characterized by warmer average temperatures and rising sea levels, but also by change in the frequency and intensity of climatic extremes. For example, the typical number of 100-degree days are expected to nearly double by 2036 and extreme low temperatures are expected to exhibit a stronger and more robust trend (Nielsen-Gammon et al. 2020). As well, precipitation events are expected to intensify as heavy rainfall is condensed into shorter periods of time (Easternling et al. 2017, Brown et al. 2019). Hurricanes are expected to become more extreme, moving slower with higher winds and heavier precipitation (Knutson et al. 2010, Sobel et al. 2016, Nielsen-Gammon et al. 2020, Seneviratne et al. 2021).

Warmer air temperatures would result in increased water, reduced dissolved oxygen, and higher evaporation rates within the marshes and open water in the project area (Meyer et al. 1999). Warmer temperatures can also increase the frequency of algal blooms, which can be toxic and further reduce dissolved oxygen levels making conditions less suitable to uninhabitable for aquatic species. Summer droughts may amplify these effects, while periods of extreme rainfall can increase the impacts on surface water through increased sedimentation, erosion, turbidity, nutrient loading and pollutant-laden run-off (EPA 2016), each of which can alter the hydrology and water quality of the project area.

While coastal wetlands have adapted to regular hurricane disturbances over time, which can have both damaging and beneficial effects, increasingly intense storms may generate extreme abiotic conditions that could marsh recovery difficult or impossible. For example, extreme precipitation events can cause excessive and prolonged flooding, which has been known to trigger regime shifts in coastal wetlands causing a transition from vegetated wetland to mud flats and/or open water (Stagg et al. 2021). This has been especially evident in the project area since

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[1] Assumed construction costs are based on TPCS estimates for the dike lift, outfall construction, and dredging cost difference between Alt 3 and Federal Interest Plan and have intentionally excluded costs associated with LERDS (01 account), planning and engineering and design (30 account), and construction management (31 account) because these actions would not contribute to fuel consumption.

the containment dike was breached in 2005 and then again in 2011 and will likely continue in the future without any restoration action. Conversely, if the project area experiences periods of drought, sudden vegetation dieback in the marsh areas could occur (Feher et al. 2017).

8.2.1.2.1 Relative Sea Level Change

The change in ocean height relative to coastal lands, called relative sea level rise, is a combination of three factors: eustatic sea level rise, local variations in sea level rise, and relative land motion. Eustatic sea level rise is the change in global mean ocean height (global mean sea level [GMSL]) and is primarily the result of increasing temperatures that cause thermal expansion and melting glaciers and ice sheets. Scientific research indicates that GMSL has risen by about 7-8 inches (16-21 cm) since 1900 and could rise between 3.6-7.2 inches (9-18 cm) by 2030 and 15-51.6 inches (30-130 cm) by 2100 (Sweet et al. 2017). Local variations are produced by changes in wind patterns and ocean currents and are minor for the Gulf of Mexico (Nielsen-Gammon et al. 2020). Relative land motion in coastal Texas is dominated by coastal subsidence, or the gradual lowering of land-surface elevation, and is the result of the extraction of groundwater, oil, or gas or increasing sediment loading or infrastructure construction.

USACE policy requires incorporation of projected changes to Local Mean Sea Level (LMSL) into the design of Civil Works projects. To attain these values, the USACE Sea-Level Change Curve Calculator (Version 2021.12) (available at: http://corpsmapu.usace.army.mil/rccinfo/slc/slcc_calc.html) was used. The calculator provides three rates of RSLC including the “low,” “intermediate,” and “high.” The “low” rate of RSLC in based on an extrapolation of historical tide gauge readings. The “intermediate” and “high” rates represent a future acceleration in sea-level change with trajectories based on modified National Resource Council curves (NRC 1987) I and III respectively considering both the most recent IPCC projections and modified NRC projections with the local rate of vertical land movement added.

The output of the calculator is dependent on using adequate historical water level data. The closest NOAA tide gauge with more than 40 years of water level data is Sabine Pass North, TX (NOAA Gage 8770570), which has a published RSLC rate of 0.01857 feet/year. At the end of the 50-year project benefit period of analysis, the water levels are projected to rise 1.54, 2.15 and 4.10 feet relative to LMSL for the low, intermediate, and high scenarios, respectively (Figure 21). The intermediate curve is the assumed rate of RSLC for purposes of this study.

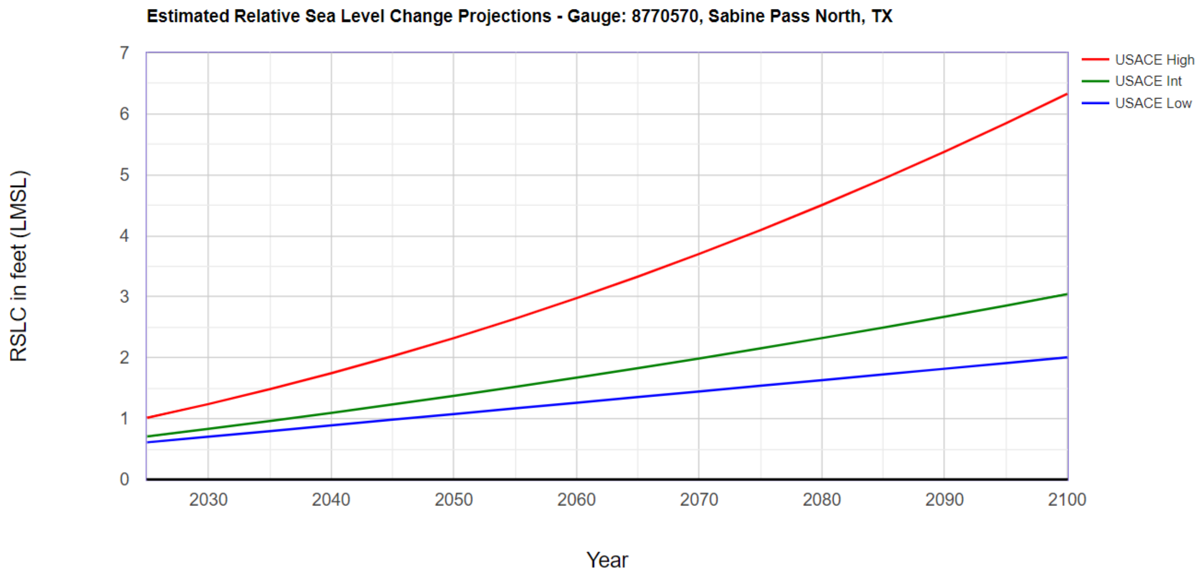

Figure 21. RSLR scenarios at NOAA Gauge 8770570, Sabine Pass North, TX

The NOAA Sea Level Rise Viewer (https://coast.noaa.gov/slr/#/layer/slr) is a useful tool to illustrate the scale of potential flooding as a result of rising sea levels. Figure 22 shows the water levels as they would appear during the highest high tides (excludes wind-driven tides) with 2 feet of sea level rise, which equates to roughly the intermediate scenario at the end of the 50-year benefit period of analysis.

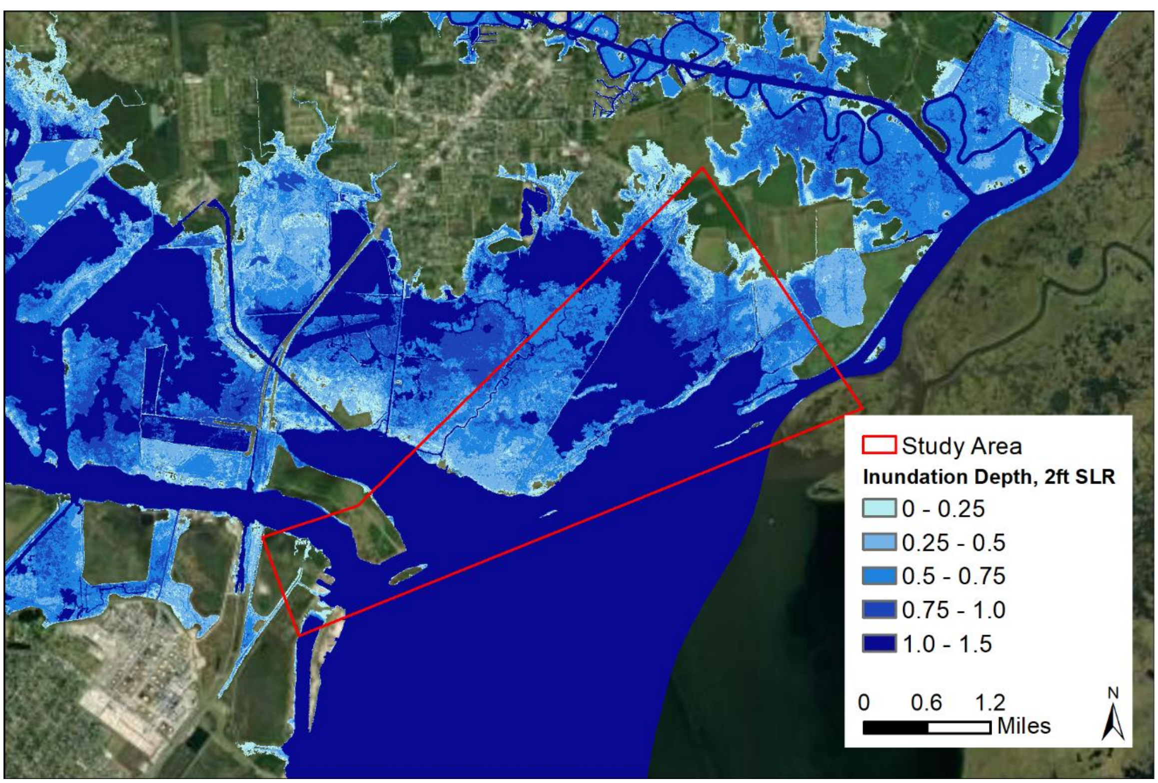

Figure 22. Overview of additional inundation (MHHW) from 2.0 feet of RSLC in Orange County, TX

As indicated, RLSR will influence the hydrology of the project area through an increase in flooding and will be an important factor controlling wetland function and sustainability (discussed in more detail in section [habitat FWOP]). Flooding is important because it defines plant zonation based upon the biological tolerances of individual species to flood depth, duration, and frequency, thus, changes in flooding can cause shifts in wetland community composition reflecting a dynamic ecological response that can also be cyclic in nature and affects the ecosystem's sensitivity and resiliency to environmental perturbations (Stagg et al. 2021). However, extreme changes in environmental conditions may surpass resilience thresholds leading to ecosystem collapse (Stagg et al. 2021) or in the case of the project area further conversion of existing marsh habitats to open water.

8.2.2. Alternative 3

8.2.2.1. Construction Activities

Similar to the No Action alternative, GHGs would be emitted during construction; however, restoration of marshes has carbon sequestration benefits that would not be observed under the Federal Standard. They act as long-term carbon sinks by removing carbon from the atmosphere through photosynthesis and storing it in their soils for long time periods. Compared to other ecosystems, coastal marshes sequester a very high amount of carbon per unit area: 7.98 tons per hectare per year (t/(ha y)) CO_2 (EPA 2017 and IPCC 2014a). As opposed to the No Action, restoration of the marsh area would increase the overall density and spatial extent of marsh vegetation. However, even more important is the increase and maintenance of the vertical sediment accretion rate, which strongly influences the rate of carbon sequestration, through placement of BU and protection from SLR or tidal energies from placement of breakwaters and the living shoreline. The sediment accretion rate dictates the potential to sequester carbon (Macreadie et al. 2017)

Using the same assumptions used for calculating the carbon emissions for the Federal Standard, Alternative 3 is expected to spend $24 million on construction[2], which is slightly less the Federal Standard and would have the roughly the same estimate for climate than emissions, which are below the threshold significance.

8.2.2.2. Performance

Alternative 3 has been designed to be effective and sustainable under the intermediate RSLR over the 50-year planning horizon. Incorporation of the breakwaters and the living shoreline reduce the tidal energies that are expected to increase and that without the measures would degrade the containment dike and allow breaches into interior marshes and likely loss of as historically has occurred. Additionally, the living shoreline provides added elevation to create a barrier against rising seas. The last layer of protection against RSLR is fixing the existing containment dike. The containment dike is of sufficient height to prevent overwash and breaches except under the most extreme events. This will as indicated earlier reduce the potential for saltwater intrusion, excessive flooding, and subsequent conversion of marsh habitats to mud flats or open water. The rate of accretion within the interior marshes is expected to be maintained be more resilient against the effects of hurricane storm surge and associated

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[2] Estimated costs use the same assumptions as for the No Action.

flooding, salinity spikes, and tidal scour, though some hurricane storm surge damage may be unavoidable.

However, there is uncertainty about how much sea level change would occur in the project area. If low rates of change occur in the project area, it would be expected that there would be no change in benefits. Under a high rate of rise, the containment dike would most likely be breached in the latter years of the planning horizon. While increasing the height of the containment dike would prevent this, doing so may cause adverse impacts and a reduction in benefits. For example, a higher containment dike would not allow extreme overwash events which are periodically needed for wetland forming processes.

8.3. Water Resources

8.3.1. Hydrology

8.3.1.1. No Action

SLR is expected to increase water surface elevations by 2.0 feet under the intermediate scenario at year 50. Additional increase in surface elevation is not expected in the project area due to the fact that the water surface slope is very mild through the system and hence the backwater effects that would serve to mitigate the sea level rise effect occur upstream of the project area. Modeling of the future 48-foot SNWW channel, indicated that average water surface elevation increase by less than 0.01 feet in addition to RSLR changes.

8.3.1.2. Alternative 3

During marsh restoration, existing fragmented marsh and shallow open water areas would be restored to marsh habitat. Temporary earthen containment/exclusion dikes, if constructed, would temporarily prevent local flows from coming into and over the marsh restoration site during construction activities. However, the dikes would be expected to naturally degrade or would be mechanically breached to provide hydrologic exchange following dewatering and consolidation of dredge sediment slurry. The temporary change in hydrologic flows through the restoration units would not be expected to modify water levels in adjacent areas or permanently alter flows or water levels.

Post-construction, marsh platforms would be elevated from their existing condition to aid in resiliency and sustainability under future conditions. The higher elevations may slightly reduce and modify local throughput (current patterns and flow) of water over the footprint immediately following construction and until the area compacts and sea levels rise. However, overall basin current patterns and flows would be similar to that which existed prior to the fragmentation, degradation and loss under the existing condition. Marsh elevation increases would also reduce the amount of ponding and allow flows to move throughout the area and drain more efficiently than under the existing condition. Marsh restoration would be expected to have an overall beneficial impact in the restoration units by inducing flow conditions more suited to functional wetlands.

The placement of breakwaters is not expected to alter flows into and out of the area nor would it alter water levels behind the structures. The structures would by design reduce velocities and protect the living shoreline and the containment dike from wave induced erosion. The proposed design is identical to those used in other areas along the GIWW in Orange and Jefferson County. To date, no adverse hydrological influences have been identified. Rather, these structures have provided overall beneficial impacts by reducing erosion caused by waves, slowing land loss, and reducing saltwater intrusion into adjacent marshes.

Constructing a living shoreline seaward of the containment dike and repair of the existing containment dike would by design would reduce tidal influence on marshes behind the containment dike, which is acting as a dune, to a more historic condition prior to the breach in the containment dike. By constructing a wider swath of land in front of the containment dike, the living shoreline would reduce wave energies and slow erosion rates of the newly created area of land and the containment dike, while repairing the containment dike would prevent tidal exchange between Sabine Lake and the interior marshes. During extreme events, storm surge and overwash may still occur as would have historically before the breaches in the containment dike occurred. Repairing the containment dike would not impede overland flows and the interior marshes would be able to drain as they historically did prior to the breaches.

The objective of the action is to restore coastal ecological functions. Each of the measures are expected to exclusively have beneficial impacts to natural floodplain values. No losses of natural and beneficial floodplain values are anticipated. The nature and extent of flooding within the base floodplain is unaffected by any of the proposed measures.

The risk of inducement of development within the floodplain is normally associated with structural projects such as dikes and floodwalls where vacant parcels are no longer subject to frequent flooding, lowering the cost of potential development and providing economic incentive for the addition of inventory to the floodplain. None of the alternatives include measures that would induce development. Implementation of any of the plans may ease the impacts of flooding under RSLC, but it would not otherwise lower the cost of developing in the floodplain as a prerequisite to providing economic incentive that could induce development.

8.3.2. Surface Water

8.3.2.1. No Action

Under RSLC, the amount of surface water in the project area is expected to significantly increase over time with an estimated 98 percent increase in unconsolidated shoreline and open water as compared to the existing condition (see section [climate no action] and section [no action biological resources marsh]).

Although Orange County is expected to see an increase in population and demand for water, expected changes in supply strategies and demands that are part of the 2016 Water Plan East Texas Region (TWDB 2015) would be expected to have only negligible impacts to surface water flows into and out of the study area.

8.3.2.2. Alternative 3

Implementation of Alternative 3 would effectively reduce the amount of open water in the interior marshes to a percentage that is more conducive to sustainable and healthy intermediate-brackish marsh conditions. Additionally, construction of the living shoreline would restore the shoreline seaward of the containment dike to its historic location, also reducing some areal extent of existing open water. As indicated in the previous section, hydrologic flows of freshwater into the bayous and marshes would not be affected by implementation of Alternative 3.

8.3.3. Groundwater

8.3.3.1. No Action

With projected future effects of climate change, there is a potential for saltwater intrusion into shallow groundwater aquifers at or near the project area due to a rise in sea levels. A USACE SWG study found that if sea level rises 0.5 inches (0.04 feet), the freshwater/saltwater interface could potentially rise as much as 1.67 feet (USACE 2009). This would be expected to have a significant impact on freshwater aquifers; however, sea levels in the project area are anticipated to rise 2.0 feet under the intermediate curve near the end of the planning horizon. Based on the USACE findings, a 2.0-foot rise would cause the interface to rise 83.5 feet. For every foot the saltwater level rises, the height of free ground surface water is reduced by one foot. As a result, the interface between saltwater and freshwater underground rises approximately 40 feet for every foot the sea level rises. This could have significant effect on the amount of fresh water in deep aquifers in the project area with or without the project and could affect saltwater intrusion into marsh areas through groundwater.

8.3.3.2. Alternative 3

Implementation of Alternative 3 is not expected to cause any measurable beneficial or adverse impacts to groundwater resources and would have no affect on municipal or private groundwater supplies.

8.3.4. Water Quality

8.3.4.1. No Action

As described in the No Action condition for soils (section [no action soils]), soils in the study area are highly susceptible to erosion leading to marsh instability. Instability and erosion frequently results in excessive sediment inputs into the surrounding marshes and open water areas, which increases turbidity and may adversely affect aquatic life and fisheries and restrict light penetration necessary for photosynthesis by aquatic plants.

Also as indicated in the No Action condition for climate (section [no action climate]), warmer temperatures would contribute to reduced dissolved oxygen and increased frequency of algal blooms, which can create toxic conditions for aquatic species. Summer droughts may amplify these effect, while periods of extreme rainfall can further degrade water quality through increased sedimentation, erosion, turbidity, nutrient loading and pollutant-laden run-off (EPA 2016).

It is anticipated that the Sabine and Neches rivers and Sabine Lake would continue to be impaired water in the future but that actions would be put into place that would mitigate the level of impairment to less than what it is under the existing condition.

8.3.4.2. Alternative 3

Implementation of Alternative 3 would result in temporary, minor adverse impacts to water quality, but would realize long-term, direct and indirect benefits over the planning horizon once construction is complete and each of the measures are functioning as designed.

Construction activities, hydraulic dredging and placement of dredged material and other fill materials could result in the following localized and temporary impacts to water quality including: reduction of water clarity; change in color; reduction in the pH of receiving area waters toward more acidic conditions; emission of reduced sulphur compounds including hydrogen sulfide often characterized as an objectionable rotten-egg smell; release of organic material with varying quantities of ammonia, nitrogen, and phosphorous, which could stimulate growth of algae and other aquatic plants. The factors responsible include increased turbidity, increased suspended sediments, and organic enrichment, chemical leaching, reduced dissolved oxygen, and elevated carbon dioxide levels, among others. Freshwater inflows and currents present in the open water areas would serve to disperse and thereby dilute localized changes. Any such impacts would be minimized and controlled by the use of the best available practical techniques and BMPs. Following construction, degraded water quality conditions would be expected to return to baseline conditions prior to construction.

No significant long-term adverse impacts to water chemistry are anticipated. During marsh restoration and shoreline nourishment, effluent from the dredge discharge pipe would be directed to adjacent fragmented marsh or into Sabine Lake. Dredged material is expected to be free of contaminants and would be suitable for placement in the aquatic habitat and is not expected to result in adverse effects to aquatic organisms.

USACE has collected and archived a significant amount of water and sediment chemistry data as well as elutriate data that provide information on the constituents that are dissolved into the water column contained during dredging and placement associated with the SNWW. Historical water and elutriate data for detected compounds from 1987, 1990, 1992, and 1998 are presented in PBS&J (2004). Lead and zinc were the only metals found above detection limits in 1987 at all stations in water and elutriate samples. One water sample from station S-SP-87-06 contained 98.0 µg/L of zinc that slightly exceeds the state water quality standards (92.7 µg/L). However, the elutriate value was low indicating no release of zinc to the water column during dredging or placement. Metals were not detected in 1990, and in 1992 the only metal found above detection limits was cadmium (in water) at station S-SP-92-06. In 1998, barium and zinc concentrations were found above detection limits for water and elutriate and were consistently higher in the elutriate samples. This contrasts to the 1987 samples, in which elutriate values were normally lower than water concentrations. Arsenic was detected at most stations in water and two stations for elutriate; cadmium and nickel were found in water only. All values, except the zinc value noted above, were below the water quality criteria and state water quality standards.

Oil and grease were detected in 1987 in water and elutriate samples. Ammonia, which was not measured until 1996 was found above detection limits in all elutriate samples for 1998. For the organics, in 1987 fluoranthene was above detection limits at one station. TOC was detected in all water and elutriate samples during 1992, and elutriate concentrations were consistently higher than water concentrations. Based on available water and elutriate data, there is no indication of current water or elutriate contaminant problems along the SNWW.

Indirect impacts of marsh and shoreline restoration include water quality improvements. Restored and nourished areas would increase the surface area in which sediments and excess nutrients can be trapped. This can in turn reduce total suspended solids in the water column and reduce phosphorus and nitrogen levels while increasing dissolved oxygen, all of which help maintain or improve local water qual

8.3.5. Salinity

8.3.5.1. No Action

SLR is expected to increase salinities in the project area by about +2.0 ppt for the median flows and +1.56 ppt for the low flows over the existing condition. Couple that with the effects of the future 48-foot SNWW and the increase for median flows rises another + 2.26 ppt (Figure 23) for a total increase of +4.26 ppt over the existing condition. Similarly, the low flows would rise about +1.0 ppt with the channel deepening to increase the total salinity to +2.56 ppt over existing condition. The increase in higher median flows than the low flows reflect a greater salinity gradient at high inflows, which allows a greater effect from the density current.

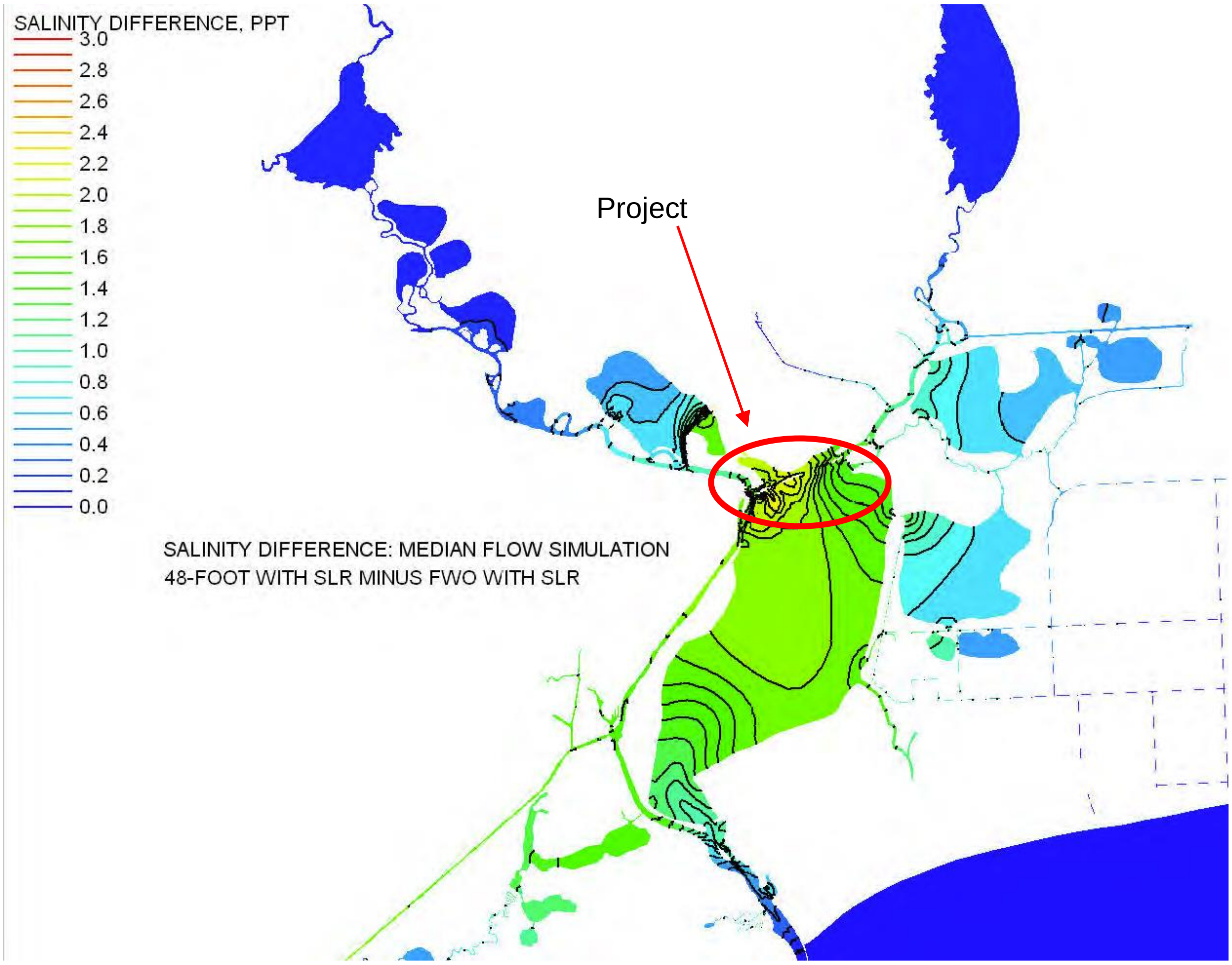

Figure 23. Salinity Change from Implementing the 48-foot SNWW Channel Deepening under the No Action Alternative.

8.3.5.2. Alternative 3

The living shoreline and repaired containment dike would provide a first line of defense against storm surge and daily tidal influences to marshes behind the dike. By reducing the frequency of saltwater inundation into the saline and intermediate-brackish marshes, the current saline marshes can moderate to intermediate-brackish, and the natural salinity regime associated with the intermediate-brackish marsh can be maintained, unlike in the No Action in which intermediate-brackish marshes are becoming more saline and saline marshes are converting to open water or mud flats. Saline marshes this high up in the watershed are unnatural and the project area is currently the only place with this type of marsh, so moderating to intermediate-brackish will align with the reference site and surrounding marshes.

8.4. Geologic Resources

The geology and mineral resources of the project area are not expected to change under or be impacted by the No Action or Alternative 3 and are therefore not assessed in this section.

8.4.1. Topography

8.4.1.1. No Action

Alterations to bathymetry from maintenance dredging and SNWW CIP would occur in the project area. Additionally, under future conditions, the height of the containment dike would be expected to lower in height allowing more frequent overwash events. As well, the containment dike would likely breach in multiple additional areas from erosion or storm surge events. Within the interior marsh areas and along the seaward side of the containment dike, sediments would continue to erode to negative elevations and convert to open water.

8.4.1.2. Alternative 3

Introduction of the dredged materials would change the topography and bathymetry of the restoration units. Approximately 60 percent of the restored marsh elevations would increase to +1.2 feet NAVD88 and 40 percent would increase to a maximum of +0.5 feet NAVD88. For these surface changes, the existing elevations are at or below +0.0 feet NAVD88, which does not benefit the system. With the increase in elevation and change in topography, the system will be able to more closely function as nature designed allowing surface flows to enter and pass rather than being trapped and create a more resilient and sustainable system under RSLC condition.

Additionally, the containment dike would be repaired to a uniform +5.0 feet and the living shoreline would be sloped from -0.5 feet NAVD88 to the existing ground elevation (+3.0 feet NAVD88) at the toe of the containment dike. Like the interior marsh areas, most of the living shoreline area is at or below +0.0 feet NAVD88.

8.4.2. Soils

8.4.2.1. No Action

Soils in the project area would continue to erode under future conditions from tidal energies through the breaches in the containment dike. As the depth of inundation and salinity of flooding increases over time, the nutrients and physical properties of the soils will begin to change. Increasing salinity correlates with a higher concentration of sulfate ions, which can be reduced to hydrogen sulfide in low redox marsh sediments. Because sulfide is toxic to plants, root production is generally expected to decline and create anoxic marsh sediments leading to further conversion of marsh to mud flats or open water (Alldred et al. 2017).

8.4.2.2. Alternative 3

Implementation of Alternative 3 would reintroduce sediments into the system through placement of dredged material during marsh nourishment, repair of the containment dike, and construction of the living shoreline. Approximately 3.5 MCY of dredged material would be placed into the restoration areas if all three units were completed during the 50-year planning horizon. This increase in sediment is expected to result in long-term beneficial impacts by increasing the amount of hydric soils in the system and creating stability. For marsh sites, the increase in sediment is expected to increase productivity, support wetland building functions, and reintroduce and distribute sediment and nutrients throughout the ecosystem, not just within the restoration unit. For the living shoreline, increased sediment would increase the available sacrificial land which would allow for wave attenuation and a reduction in erosion of the containment dike and subsequently interior marshes.

Based on observations in other locations where breakwaters have been constructed along the GIWW, accretion of sediments on the landward side of the breakwaters is likely. As vessels pass by the structures, sediments are stirred up and migrate behind the breakwater where they settle out and effectively accrete additional sediment and surface area. This can lead to formation of mudflats or once accreted to a sufficient elevation establishment of marsh.

All soils in the marsh restoration units are hydric soils. During construction, hydric soils in the project area would be minimally compacted from heavy equipment moving and placing dredged material within the restoration unit. Compaction would be temporary and would be expected to have a compaction rate similar to the reference marsh shortly after construction ceases and the marshes are under normal surface flow influence. Placed material would be of very similar quality as the existing soil, which would reduce any compositional or structural changes associated with placing an outside source into the marsh.

8.4.3. Coastal Erosion

8.4.3.1. No Action

Under the No Action, shoreline loss is anticipated to continue eroding at a rate of approximately four feet per year as is observed under the existing condition. As a result, the shoreline is expected to migrate in approximately 200 feet over the 50-year period of analysis. For approximately, 9,000 feet of the eastern half of the existing containment dike, erosion is anticipated to completely breach the containment dike (i.e. the existing shoreline in front of the containment dike is less than 200 feet wide) or begin eroding the toe of the dike over 50 years where shorelines are not much wider than 200 feet under the existing condition. Of the 9,000 LF, approximately 2,600 LF of shoreline is less than 50 feet wide under the existing condition and the containment dike toe is already being affected.

8.4.3.2. Alternative 3

With construction of the breakwaters, shoreline loss would be nearly stopped or result in at a minimum negligible change in shoreline position from the existing condition over the 50-year period of analysis. Where the living shoreline is being constructed, the shoreline position would be closer to its historic alignment, which is anticipated to at a minimum be maintained because of the presence of the breakwaters. Accretion of sediment behind the breakwaters is expected to occur, as has been observed behind constructed breakwaters in other locations along the GIWW. This will then result in accretion of the shoreline and marsh habitat.

8.5. Biological Resources

8.5.1. Habitats

8.5.1.1. No Action

Under the No Action, increased saltwater intrusion and introduction of tidal energies to historically non-tidal or micro-tidal intermediate-brackish marshes in the project area is expected to continue causing plant mortality, peat collapse and erosional loss of organic marsh soils, leading to habitat switching (e.g. intermediate-brackish marsh to salt marsh) and conversion of vegetated marshes to open water or mud flats. These impacts have been and will be most severe in the interior marshes where saltwater gets trapped behind the containment dike and very slowly drains within minimal freshwater inflows to dilute higher salinity water.

In open water habitats, salinity changes from increased rainfall or tidal influences, increase in water temperatures, extreme weather events, and increased absorption of CO_2 is expected to continue contributing to a reduction or redistribution of habitat forming organisms, nursery habitat for commercially significant fish species and suitable habitat for rare or imperiled species.

Using the NOAA Marsh Migration Viewer, approximately 98 percent of the existing marshes in the project area under the existing condition are expected to convert to unconsolidated shoreline or open water over the 50-year planning horizon under an intermediate RSLR scenario (Figure 24 and Table 20).

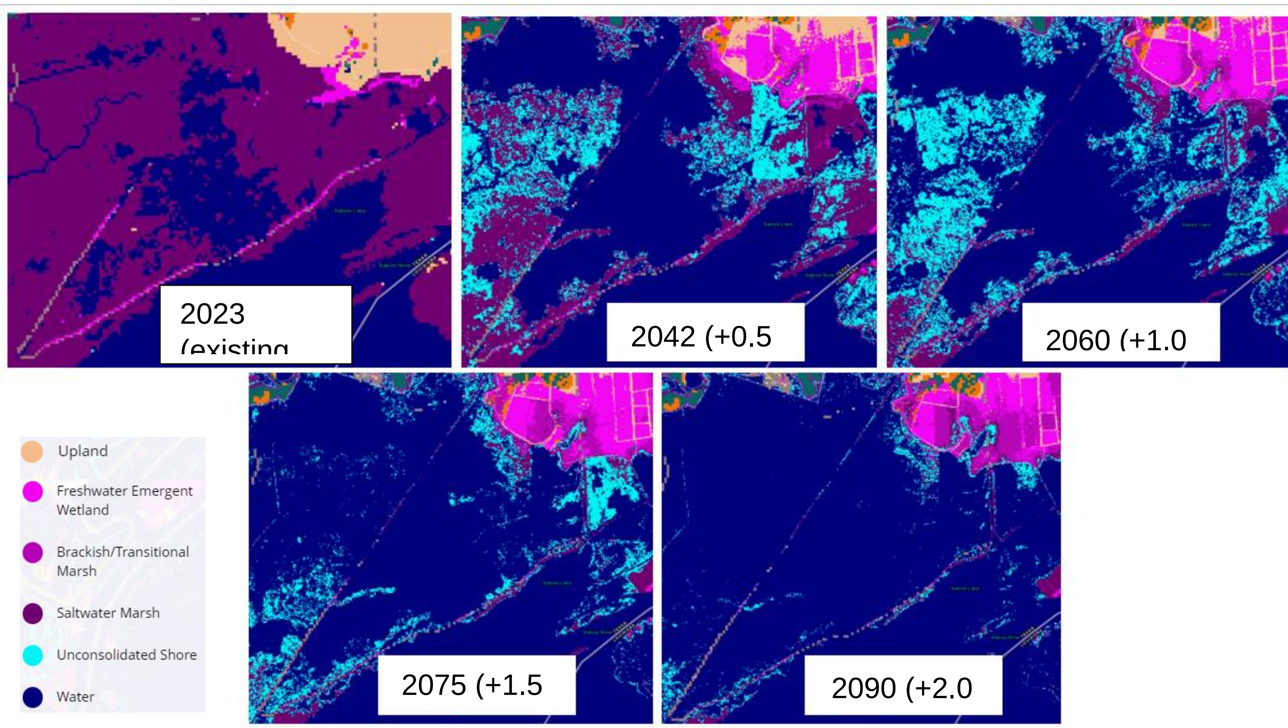

Figure 24. Projected Marsh Remaining with Each Additional 0.5-Foot (MHHW) Rise in Sea Levels (NOAA 2017)

Table 20. Projected Area of Marsh under Rising Sea Levels

NOAA Elevation (MHHW)	Correlated USACE Intermediate Curve (MHHW)	Corresponding Year	% Marsh Remaining	Marsh Remaining (Acres)
0.0	1.30	2023	100%	629
+0.5	1.79	2042	25%	157
+1.0	2.31	2060	15%	94
+1.5	2.79	2075*	2%	12.58
+2.0	3.31	2090*	0%	0

*Beyond 50-year planning horizon

8.5.1.2. Alternative 3

Under Alternative 3, marsh restoration would convert open water habitat to intermediate-brackish marsh and any saline marsh in the restoration units would be converted to intermediate-brackish marsh. Placement of dredged material into degraded marsh habitat would realize a temporary decrease in functional value and spatial extent, but a long-term net increase in the functional value and area of marsh in the restoration units (**Error! Reference source not found.**) when compared to the existing condition or No Action. The functional value increase is expected to be realized within three years post-construction.

During construction activities, it is anticipated that there would be a temporary decrease in aquatic habitat quality due to increased sedimentation from work being done in and near open water. Additionally, placement of dredge material into open waters areas for marsh restoration would result in an immediate loss of shallow open water and a gain of land.

Within marsh areas and along the living shoreline, placement and reworking of dredged material by construction equipment would cover and trample marsh vegetation throughout the construction footprint. Minimal emergent vegetation would be present immediately after construction as most of the project area would be unvegetated dredged material. Areas which were already marsh would likely revegetate more rapidly than large, open-water areas which are filled in. Marsh vegetation nourished with 6 to 12 inches of material has been shown to respond favorably and revegetate quickly. Large, open-water areas which are filled with dredged material would likely revegetate at a slower rate than nourished marsh. Areas of significant concern for erosion or formation of a monoculture communities would be planted post-construction. Areas that are not planted would be expected to fully revegetate to densities, heights, and compositions similar to the reference marsh within 1 to 2 years after construction. All areas of the living shoreline would be planted with saline tolerant vegetative species plugs, spaced 60 inches apart, so that vegetation can be quickly established and the shoreline is not eroded away.

Earthen retention dikes would be constructed from borrow taken from within each marsh creation site. The dike features would be mechanically breached or degraded within three years of construction if natural degradation has not sufficiently removed the earthen material. Impacts from the construction of retention dikes would be considered temporary and would be mitigated by natural or induced recruitment of native vegetation.

Additionally, vegetation found within the construction years, along the temporary access routes and any other areas required for construction operations would be removed or disturbed while the area is in use. Subsequent to completion of construction, disturbed areas would be planted and seeded to mitigate any long-term impacts. When siting temporary construction sites, sensitive habitats would be avoided and where possible already disturbed areas, such as well pads, agriculture fields, or vacant lots, and existing roadways would be utilized to avoid further degradation to intact or higher quality habitats.

Construction of the breakwater would result in approximately 8.7 acres of submerged bottomlands and inland open water habitat being permanently converted to a hardened structure. This conversion would occur over a narrow (~26 feet) but long (~14,623 LF with breaks in the structure for circulation and fishery access) portion of the habitat in which it is being placed. The breakwater, living shoreline and repair of the containment dike would benefit wetlands over the long-term by reducing wave energies and slowing the rate of land loss and reducing saltwater intrusion.

8.5.2. Fisheries and Wildlife

8.5.2.1. No Action

Effects of climate change on ecosystems are difficult to predict, due to both uncertainty in climate change scenarios (direction and magnitude of temperature and precipitation) and uncertainty in understanding how species will respond to those changes. In the future, it is reasonable to expect some native marsh-dependent species will move out of their current distribution in the project area to seek habitat which meets their life requisites given the decrease in marsh habitats projected for the project area. Conversion of intermediate-brackish marsh to more saline conditions or open water will likely result in a decrease in abundance of existing species due to loss of suitable habitat. However, such range shifts are only feasible with adequate habitat, good dispersal and colonization ability, availability of food resources, and absence of physical barriers which might preclude movement. Displaced species may suffer from increased competition or predation, be susceptible to disease or be maladapted to their new environment. Range shifts would be expected in avian species and larger mammals; however, small mammals, herpetofauna and species with limited range mobility are expected to adapt to their new conditions or become extirpated in that portion of their range. During the adjustment period, wildlife demographic responses may include alterations in social groups, reproductive success, and age or sex ratios. Whether a species seeks new habitat or remains in place, all species will react independently and be affected at different rates according to their ecological and physiological constraints (Root and Schneider 2006)

With range shifts, it is probable that different species will move into the now ecologically free space and increase in abundance, which can lead to establishment of monocultures or invasive species. An increase in the extent, frequency, and severity of invasive species and a shift toward invasion in species that have not historically been invasive is also expected.

In open water habitats, altered habitat structure and quality affects species at the population level. As described for marsh-dependent species, changes in distribution, abundance and diversity of communities and species is anticipated. The reduction and/or modification in habitat may reduce overall yield from fisheries through a shrinking of the number, size, and distribution of species.

At the individual level, climate change can have a direct effect on growth and reproduction, changes in spawning periods and duration, lower recruitment, weakening of exoskeletons, and increased stress through changes in metabolism and oxygen consumptions. However, it is possible that some aquatic species may benefit from habitat shifts. For example, coral cover is being reduced due to increased sea temperatures and ocean acidity; however, macroalgal cover is increasing where coral was lost (Bell and Coauthors 2013). Fish species that benefit from algal rich habitat may be able to exploit this change and thrive, while those that rely on coral habitats are expected to suffer (Pearson and Connolly 2016)

8.5.2.2. Alternative 3

Construction-related activities are anticipated to impact individuals of fish and wildlife, if they occur as a resident, migrant or incidental, within or near the project area. Impacts include habitat removal and/or fragmentation during construction activities and habitat avoidance because of increased noise, dust generation, vibrations, and overall lower quality habitat. Losses of slow moving and less mobile species (small mammals, aquatic invertebrates, benthic species, mussels, smaller/younger fish, and herpetofauna) are anticipated along the access roads and within the construction footprint, particularly during placement of dredged material or stone/rock causing burial of individuals and/or increased turbidity. Faster moving species are expected to be able to avoid injury or death while crossing access roads and by avoiding the construction area. In general, most wildlife, fish, and benthic species would become habituated to the on-going work including adapting to the habitat changes; however, species with a low tolerance to activities are anticipated to be displaced for the duration of activities. The level and duration of the impacts is dependent on the final design of each restoration measure, type of equipment used, and duration of construction activities. However, it is anticipated that once construction is complete, construction-related impacts to individuals would cease.

Benthic, plankton, suspension/filter-feeding species, visual predators and other fishery and aquatic organisms could have short-term localized adverse indirect impacts caused by increased turbidity, total suspended sediments, and water temperatures and lower dissolved oxygen levels from dredging and construction. Benthic organisms could be smothered. Suspension/filter feeding organisms could be impacted due to clogging of the gills and feeding mechanisms which could either cause death or reduce growth and reproduction. Visual predators would have a reduced success rate at catching prey due to lower visibility levels. Following construction activities, turbidity and suspended sediment levels, water temperature, and dissolved oxygen levels are expected to return to pre-construction conditions. These temporary and localized impacts would be minimized and controlled by implementing the best available practical techniques and BMPs during construction.

From a long-term perspective, implementation of Alternative 3 would result in improved habitat conditions for marsh-dependent and shoreline species. A greater diversity and increased abundance of emergent and submerged vegetative species would result in a greater food supply for herbivores, which then results in a greater abundance of herbivores to feed predators. Increasing the amount of marsh edge and construction of the living shoreline would also provide increased foraging opportunities for shorebirds and wading birds using shoreline habitats. Nesting habitat would improve as the marsh platform would provide more desirable nesting habitat. The increase in vegetative structure would also provide more cover for prey species.

Although marsh restoration would result in the loss of approximately 60 percent of the existing open water in the restoration units, wildlife species currently utilizing this habitat would not be expected to be adversely affected since most of these species are highly mobile allowing them to relocate into adjacent open water habitats outside the restoration units. The conversion of open water to marsh habitat is generally considered a benefit to aquatic species.

Construction of the breakwater would convert inland open water habitat to a hardened structure thereby reducing available habitat for aquatic species and resulting in the loss of immobile species. However, these impacts would have an overall minimal impact to fisheries and aquatic populations in the area and would in the long-term protect adjacent habitat that aquatic species depend on for survival that would be lost in the future if the measures were not. implemented As well, the structures would be designed in such a way as to not hinder movement of aquatic species and where practicable, materials would be used that would facilitate formation of a reef to support a greater abundance and diversity of aquatic species. Rock substrate is expected to also provide benefits to some aquatic species by providing them a refuge from predation.

As with any ground-disturbance activity, the probability of introducing, spreading, and/or establishing new populations of invasive, non-native species, particularly plant species, exists. Restoration plantings, soil inputs, vegetation clearing, construction-related disturbance, or incomplete habitat conversion may facilitate colonization of invasive plant species. Marshes are often prone to invasion due to high levels of resources (e.g., high fertility and high moisture). Additionally, exotic species may be the first to colonize after a planned disturbance even if they were not present in the pre-disturbance community and may alter successional processes that would otherwise lead to a native assemblage. BMPs, such as cleaning all equipment prior to entering the construction area to avoid the spread of invasive species into the project area and monitoring for establishment of undesired species, would be employed to minimize the introduction and spread of invasive species into the construction area.

8.6. Protected Species

8.6.1. Threatened and Endangered Species

8.6.1.1. No Action

Under the No Action, the conditions described for Fish and Wildlife (section [Fish and Wildlife]) would also apply to Federally-listed species. As loss of coastal marshes throughout the country continues, it is likely that there will be an increase in species warranting conservation and protection and even extirpation of some over the 50-year analysis period.

8.6.1.2. Alternative 3

The impacts described in Section [Alt 3 wildlife and fisheries] would also apply to ESA-listed species.

A Biological Evaluation was prepared to document the impacts of implementing the TSP on listed species (Appendix B). Based upon the findings of the BE, USACE determined that Alternative 3 would have no effect on piping plover, rufa red knot, oceanic whitetip shark, giant manta ray, any of the four whale species or any of the five turtle species due to lack of suitable habitat in the project area. The following effects determination for species that were identified as occurring or potentially occurring in the action area were made:

- **Eastern black rail:** Marsh restoration and construction of the living shoreline would occur in degraded open water habitat but would be within 100 feet of suitable habitat. Implementation of the action *may affect, but not adversely affect* Eastern black rail because conservation measures have been incorporated into the plan to reduce the potential impacts to the individuals that may be in nearby suitable habitat.

- **Whooping crane:** Restoration work could potentially disrupt individual birds during foraging activities. Conservation measures have been incorporated into the plan to reduce the potential impacts to the species. Implementation of the action *may affect, but not adversely affect* whooping.

- **West Indian manatee:** Due to the rarity of the manatee in the project area and the conservation measures that would be implemented, implementation of the action ***may affect, but not adversely affect*** the West Indian manatee.

Marsh restoration activities would occur in degraded open water habitat, but it would be in close proximity to stands of smooth cordgrass. The conservation measures include preconstruction surveys to ensure individuals are not present. From a long-term perspective, the restoration of the tidal salt marshes will be beneficial for the species because that is one of the preferred habitats of eastern black rail. USACE has determined the proposed action may affect, but is not likely to adversely affect the eastern black rail because the temporary adverse impacts are anticipated to be insignificant and discountable, especially since conservation measures have been incorporated into the plan, and the overall beneficial impacts would far outweigh any negative impacts.

Breakwaters are expected to benefit Federally-listed shorebirds such as piping plovers, red knots, and least terns. Breakwater structures would provide a hard surface for oysters and clams to colonize. Colonized hard structures such as breakwaters can provide habitat for fish, crabs, and invertebrates, which would attract red knots and whooping cranes (see Section 5.4.2.2; Cornell Lab of Ornithology, 2018). Accretion of sand and sediments behind the breakwater structure would increase tidal flat areas for foraging and loafing shorebirds such as piping plovers (USFWS, 1996). Breakwater ER features would also indirectly benefit Federally listed shorebirds and inland species by providing coastal shoreline protection from erosive wave action from barge traffic or rising sea levels.

8.6.2. Migratory Birds

8.6.2.1. No Action

Impacts to migratory birds would be identical to the impacts described for general wildlife species (section [Alt 3 fisheries and wildlife]).

8.6.2.2. Alternative 3

Habitats in the project area provides migratory bird shelter, nesting, feeding, and roosting habitat. As described in Section [Alt 3 fisheries and wildlife], all adverse impacts to migratory birds would occur during construction and cease post-construction. Significant beneficial impacts to migratory birds would be expected from ecosystem restoration measures. Restoration of marsh and creation of a living shoreline would result in an overall net increase in functional value and ultimately support larger populations of species and potentially increase species diversity.

During construction, there is a potential for harm and/or harassment of nesting migratory birds. Attempts would be made to conduct all restoration activities outside of the nesting season; however, this may not be possible, due to the timing of dredge availability and the extended length of the nesting season for some species. Prior to construction commencing, if during the nesting season, nest surveys should be completed. If nests are identified, all construction activities should observe a 1,000-foot buffer of any colonial-nesting waterbird colonies (e.g. egrets, herons, ibis, pelicans, etc.); a 1,300-foot buffer for any shorebird nesting colonies (e.g. terns, gulls, plovers, skimmers, etc.); and a 2,000-foot buffer for any brown pelican nesting colonies near the active construction site. Although unlikely in the project area due to lack of suitable nesting sites, if bald eagle nests are documented a buffer of at least 330 feet should be maintained between active construction and the nest and clearing of vegetation should be restricted within 660 feet of the nest site year-round (USFWS 2007). Coordination with USFWS should be completed prior to construction if nesting has been identified and USFWS guidelines should be followed to avoid adverse impacts to these species. By implementing these conservation measures there should be no adverse effects to migratory birds, including bald eagles.

8.6.3. Essential Fish Habitat

8.6.3.1. No Action

Impacts to EFH and Federally-managed species would be identical to the impacts described for general fishery species (section [Alt 3 fisheries and wildlife]). Under the No Action, continued breach of the containment dike and rising sea levels would introduce new pathways for Federally managed-species to use more interior marsh and open water areas within the project area and surrounding lands. However, most of this habitat will convert to less productive estuarine water column and estuarine mud bottom habitat type and essentially extend the surface are of open water of the Sabine Estuary.

8.6.3.2. Alternative 3

Implementation of Alternative 3 would result in the containment dike being repaired to the historic crest elevation of +5.0 feet NAVD88, which would block movement of Federally-managed species into and out of the interior marshes. However, under current conditions sufficient dike remains even in the breached areas that movement into and out of the interior areas is severely limited to only during extreme high-water events and is not regularly used by Federally-managed species. Therefore, any beneficial or adverse impacts of converting existing open water and degraded marsh (combination of estuarine marsh and estuarine mud bottoms EFH) to estuarine marsh (marsh edge, submerged aquatic vegetation, marsh ponds, and inner marsh EFHs) because of marsh restoration actions would be negligible and insignificant.

The primary impacts to EFH and Federally-managed species is on the seaward side of the containment dike where the living shoreline and breakwaters would be constructed. Construction of the living shoreline would increase marsh EFH types but would bury existing EFH substrates (estuarine mud bottoms and estuarine water column). Establishment of submerged aquatic vegetation (SAV) EFH may also occur along the living shoreline but would be limited by depth and turbidity, not seed source. Increase in those habitat types would benefit postlarval/juvenile and subadult brown shrimp; postlarval/juvenile and subadult white shrimp; and postlarval/juvenile red drum, which would offset the loss of mud bottoms that would adversely affect subadult brown shrimp and postlarval/juvenile red drum. In general, restoration actions would restore EFH habitats that are more productive.

Construction of breakwaters would convert open water (estuarine mud bottoms) to rock which is not considered EFH. However, the loss of EFH would be offset by the long-term protection of valuable EFH habitats such as marsh and SAV from erosion, which then also maintains valuable nursery grounds for the many fish and shellfish species that live within the estuaries. As well, the quality of EFH in the immediate vicinity would increase due to a decrease in long-term turbidity and suspended sediments from continual erosion and land loss.

During construction adverse impacts to Federally-managed species are anticipated. Construction activities may change EFH species' normal behaviors, such as foraging and hunting, as a result of noise and/or temporary, minor changes to water quality, such as increased turbidity, total suspended sediments, and water temperatures and lower dissolved oxygen levels in the water column. These effects would be short-term and localized and the area would be expected to return to baseline conditions following completion of dredging and construction activities. Individuals could be injured or killed through contact with the construction equipment or could be smothered under the dredged or breakwater material. However, any loss of Federally-managed species would not be expected to affect populations of EFH species that inhabit the project area or the region. In general, direct impacts to EFH species is dependent on the life stage of the species and their usage of the project area (i.e. eggs and larval fish will be affected to a greater extent than adults and juveniles because the older life stages have greater swimming abilities and will be able to move away from construction activities).

As part of Magnuson-Stevens Fishery Conservation Management Act, any Federal agency that authorizes, funds or undertakes, or proposes to authorize, fund, or undertake an activity which could adversely affect EFH is subject to the consultation provisions of the Act and identifies consultation requirements (50 CFR Sections 600.805 - 600.930). This integrated feasibility report and environmental assessment was prepared to serve as the EFH assessment. Since no significant adverse impacts are anticipated and the project as a whole is largely beneficial to EFH species, no mitigation has been proposed.

8.6.4. Marine Mammals

8.6.4.1. No Action

Under changing future climate conditions, a shift in the distribution of common bottlenose dolphins is possible as temperatures and habitats change, accompanied by a shift in the distribution and abundance of prey species. There are also likely to be changes in the distribution of pathogens, so naïve populations may be exposed to new diseases. The impacts of climate change on common bottlenose dolphin populations will depend on their ability to adapt to change and on the continued availability of suitable resources and habitat available for the dolphins and their prey. It is assumed that any future dredging or in-water work would comply with the Marine Mammal Protection Act, which prohibits take of marine mammals and if adverse impacts are possible, mitigation would occur to minimize or compensate for the impacts.

8.6.4.2. Alternative 3

Impacts to marine mammals from implementation of Alternative 3 could occur during in-water activities occurring in Sabine Lake, such as set-up/take-down of dredged material transport pipes, operations of watercraft and heavy equipment, placement of stone for breakwater construction, etc. Impacts could include temporary habitat avoidance, exposure to underwater sound, and visual disturbances, which would all cease after construction is complete. The most extreme impact could include entrapment and/or collision with pipes, silt barriers, pumps, placement equipment, or other construction equipment. Although this is unlikely due to the relatively low occurrence rate of bottlenose dolphins and extremely rare occurrence of West Indian manatee in the project area, additional measures are being incorporated into the plan to avoid potential incidental harassment and "take" of marine mammals. The following mitigation measures would be implemented:

- Qualified biologists would monitor the presence of marine mammals during phases which involve open water areas capable of supporting marine mammals.
- Before activities occur in open water areas, a 50-foot radius of the work area should be delineated. If any marine mammal is observed within the 50-foot radius, the biological monitor shall halt construction activities, including shutting down any running equipment until the animal has moved beyond the radius, either through sighting or by waiting until enough time has elapsed (approximately 15 minutes) to assume that the animal has moved beyond the buffer.
- If siltation barriers are used, they will be made of material in which marine mammals cannot become entangled, should be properly secured, and regularly monitored to avoid mammal entrapment.

No long-term adverse impacts to marine mammals are anticipate, since the alternative does not involve measures that would reduce the food base, block or limit passage to or from biologically important areas, or permanently destroy habitat. The anticipated impacts are not expected to rise to the level of significant or result in the need for NOAA to issue an Incidental Take Authorization, especially with the incorporation of the mitigation measures listed above.

8.7. Cultural Resources

8.7.1. No Action

Under the No Action, there would be no change in cultural resources as compared to the existing condition. Cultural resources potentially present, but not yet identified, would continue to be subjected to erosional forces and fluctuating and rising sea levels.

8.7.2. Alternative 3

Activities associated with the project area include dredge placement in marsh restoration areas, dredge placement to construct a living shoreline, repair and heightening of the existing containment dike, and placement of rock with a potential for fabric underlay depending on the soils present to create breakwaters. The preliminary project area includes the maximum horizontal footprint of all areas of direct and indirect impacts from placement of dredge material, construction of breakwaters, dike repair, water level alterations within the marsh caused by dredge material placement, and all terrestrial horizontal and vertical ground disturbance activities (Figure 16). Twenty-two known terrestrial archaeological sites are within the focused study area. Sixteen of those known sites have been recorded in the project area to be directly impacted by placement of dredge material for the proposed living shoreline and marsh restoration. No known submerged archaeological sites are within the focused study area.

A terrestrial cultural resources survey for this project is not warranted as any sites within the project area would now be buried by dredge material overburden, heavily eroded by wave action, or a series of both. Access to the marsh dredge placement areas would encounter similar survey access issues of high-water table and dense vegetation that the 1973 survey encountered, with very little possibility of identifying new archaeological sites. Additionally, the shoreline in the project area has eroded due to wave action and navigation traffic. Much of the shoreline has experienced significant loss, to the point that the containment dike surrounding the marsh has been breached. This has allowed estuary water to enter the marshes where sediments are continually eroded to the point that approximately 80 percent of the project area is now open water.

As the proposed activities will restore marsh water levels and prevent on-going erosion, the placement of dredge material will protect remnants of terrestrial sites present within the focused study area from damage caused by further erosion. The marsh restoration areas within the focused study area have been subjected to dredge placement in the past, therefore additional dredge placement in the area will not affect cultural resources present. The project does not impact known historic properties listed in Table 5 based on background research conducted through the Texas Historical Commission's (Atlas) database and will have No Potential to Cause Effects to historic properties.

8.8. Socioeconomics/Economics

8.8.1. No Action

Growth in population is expected to follow historic trends and those projected in the East Texas Regional Water Planning Area 2021 Regional Water Plan (TWDB 2020) and employment, business, and industrial activity in the MSA is expected to follow economic trends in national economies.

Under the No Action, placement of material into a PA would not contribute to restoration of lost marshes and habitat that many individuals and the private landowner depend on to support ecotourism businesses. Within the project area, nearly all marsh areas would convert to open water resulting in a complete loss of business opportunities (hunting leases) for the landowner and would likely result in the closure of the Hawk Club.

8.8.2. Alternative 3

Implementation of Alternative 3 would restore marshes and create resiliency under future climate conditions, which will positively contribute to ecotourism opportunities in the project area and the greater MSA.

No environmental justice (EJ) communities were identified in the census tract containing the project area; therefore, no EJ communities would be adversely affected as a result of implementing the action.

Additionally the action is not expected to disproportionally affect children due to the remoteness of the project area relative to the nearest schools and residences (>1.5 miles away) and the overall benefit of ecosystem restoration to the environment and the communities nearby.

8.9. Aesthetics and Recreation

8.9.1. No Action

The aesthetic value of the area suffers each time there is any intrusion in the natural environment by man. The primary issue associated with visual resources is the degree of visible change that may occur in characteristic landscapes, viewsheds, and areas with high scenic value. Construction activities can introduce differing elements of form, line, color, and texture into the landscape through construction or placement of constructed features such as roads, structures, equipment, or manipulation of vegetation. Effects can also result when actions change scenic integrity or result in conditions that produce unattractive landscapes.

Impacts associated with the dike lift and dredging include visibility of construction disturbances, constructed structures, and temporary roads. Vegetation clearing and/or placement of dredged material over existing vegetation would present an obvious contrast in color with the surrounding vegetation. The PA would be visually prominent at foreground and middleground distance zones, especially since the dike height would be substantially higher than the surrounding environment. The modified PA would be most obvious immediately after construction.

Temporary adverse impacts on the aesthetic and recreational value of the area from construction and ground disturbance is certain; however, the level of impact, by nature, is subjective and difficult to quantify. Short-term impacts may occur where construction-related equipment, activities, and dust could be visible to observers. Impacts would be anticipated in years in which construction is implemented. Alternatives that do not include construction of structures, would realize only temporary aesthetic degradation until the disturbed area blends in with the surrounding environment, at which time, it would be anticipated that the aesthetic value of the area would be improved over the existing condition.

During the period of construction, recreationists on public or private lands outside the PA or on Sabine Lake may experience an increase in noise from operation of equipment that could impact their ability to seek solitude or may reduce the success of wildlife-dependent recreation activities. Additionally, as a public safety measure, boating would be prohibited near the operating construction equipment (and sediment placement locations). Recreational access and opportunities would return to preconstruction conditions following completion of the project and not result in any long-term beneficial or adverse impacts.

8.9.2. Alternative 3

Implementation of Alternative 3 would induce temporary impacts to aesthetic and recreation similar to the No Action. Construction would induce diminished or restricted recreation opportunities and temporary degraded aesthetic value until the disturbed areas blend to the surrounding environment.

For marsh restoration and living shoreline areas, obvious aesthetic changes from the surrounding environment would remain until vegetation has established and the system has begun to function as designed. Temporary placement of training berms, staging areas and access roads would be visually obvious until use of these areas is discontinued and the area is restored or the structure is removed. Natural restoration would be expected to occur over a period of a couple of years as compared to areas that are assisted with restoration which could take as few as a couple of months. As restoration proceeds, aesthetic degradation would decrease as the disturbed surface begins to blend in color, form, and texture. In general, restoration measures would be beneficial to the aesthetic value of the area and pleasing to observers.

From a long-term perspective, constructed features, such as the breakwaters and containment dike, would be substantially shorter (9 to 13 feet shorter) and less obvious when compared to the surrounding environment that would occur with a dike lift under the No Action. The containment dike crest height would be restored to a uniform elevation consistent with historic elevations (+5.0 feet NAVD88) and likely not be noticeable to individuals who are familiar with the project area. The breakwaters would have the greatest potential to permanently alter visual conditions due to use of stone material and placement in open waters. The structures would be only visible while they are being passed in vessels using the GIWW. The structures would be only slightly above the water surface elevation (about 3 feet) and would not be expected to affect the overall aesthetics of the environment or decrease the value of the area to the viewer.

8.10. Hazardous, Toxic and Radioactive Waste

Impacts to HTRW from the No Action or Alternative 3 are not anticipated since no HTRW sites were identified in or near the project area.

9.0 Environmental Compliance

This IFR/EA has been prepared to satisfy the requirements of all applicable environmental laws and regulations and has been prepared using the Council on Environmental Quality (CEQ) 2020 NEPA regulations (40 CFR Part 1500–1508) and the USACE's regulation ER 200-2-2 – Environmental Quality: Policy and Procedures for Implementing NEPA, 33 CFR 230. In implementing Alternative 3, the USACE would follow provisions of all applicable laws, regulations, and policies related to the proposed actions. The status of compliance of the project with the most common laws applicable to USACE studies is presented in Table 21.

Table 21 - Environmental Compliance of the TSP

Policies	Compliance Status	Notes
Public Laws		
Abandoned Shipwreck Act of 1988, as amended	Not Applicable	
Archeological and Historic Preservation Act of 1974, as amended	In Progress	
Bald and Golden Eagle Protection Act of 1940, as amended	Compliant	Section [Alt 3 Migratory Birds]
Clean Air Act of 1970, as amended	Compliant	Section [Alt 3 Air]
Clean Water Act of 1972, as amended	Compliant	Appendix X
Coastal Barrier Resources Act of 1982, as amended	Not Applicable	
Coastal Zone Management Act of 1972, as amended	In Progress	Appendix X
Endangered Species Act of 1973, as amended	In Progress	Section [Alt 3 T&E], Appendix X
Farmland Protection Policy Act of 1981	Not Applicable	
Fish and Wildlife Coordination Act of 1934, as amended	In Progress	Appendix X
Magnuson-Stevens Fisheries Conservation and Management Act of 1976, as amended	In Progress	Section [Alt 3 EFH]
Marine Mammal Protection Act of 1972, as amended	Compliant	Section [Alt 3 Marine Mammals]

Policies	Compliance Status	Notes
Marine Protection, Research, and Sanctuaries Act of 1972, as amended	Not Applicable	
Migratory Bird Treaty Act of 1918, as amended	Compliant	Section [Alt 3 Migratory Birds]
National Environmental Policy Act of 1969, as amended	In Progress	
National Historic Preservation Act of 1966, as amended	In Progress	Section [Alt 3 Cultural]
Native American Graves Protection and Repatriation Act of 1990	Not Applicable	
Rivers and Harbors Act of 1899, as amended	Compliant	
Wild and Scenic Rivers Act, as amended	Not Applicable	
Executive Orders		
Environmental Justice (E.O. 12898)	Compliant	Section [Alt 3 Socioecon]
Flood Plain Management (E.O. 11988)	Compliant	Section [Alt 3 Hydro]
Protection of Wetlands (E.O. 11990)	Compliant	Section [Alt 3 Habitats]
Protection of Children from Environmental Health Risks (E.O. 13045)	Compliant	Section [Alt 3 Socio]
Invasive Species (E.O. 13751)	Compliant	Section [Alt 3 Wildlife/Fisheries]
Migratory Birds (E.O. 13186)	Compliant	Section [Alt 3 Migratory Birds]

10.0 Cost Considerations Following Plan Formulation

Following identification of Alternative 3 as the TSP, the PDT reviewed the project cost in response to VT guidance to assess cost reduction opportunities and to respond to quality control recommendations.

10.1. Value Engineering Considerations

The PDT explored whether feature designs are appropriately scaled for the project need because the estimated project cost is significantly higher than the initial proposal submitted and selected for the pilot study program. The PDT applied Value Engineering (VE) principles to consider whether feature refinements might lower project costs but achieve the same function.

Applying VE principles required the PDT to consider the essential function of each feature to achieve that function at the lowest possible cost. Opportunities to refine the measure and reduce cost were considered in the shoreline protection component design and in the living shoreline. The breakwater was reviewed to consider whether another scale or type could achieve a sustainable restoration effort over the study period. The PDT confirmed that the breakwater design is consistent with current breakwater design and construction by USACE and DU to reduce coastal forces for habitat restoration efforts along the Texas coast. The PDT considered that the containment levee is necessary to prevent salinity intrusion, and the breakwater protecting it extends northeast into an area of Hickory Cove Bay already protected by land at the outlet of the Sabine River. Since this section of land offers some protection from the navigation channel, the PDT assessed whether a section of breakwater parallel to it could be shortened, while the marsh area, containment levee and living shoreline components remain the same. An adjusted breakwater length and the reduced quantities are presented in Appendix A, Engineering, Section 7.2.

The land mass blocking direct wave energies from passing vessels is approximately 0.5 miles south of the containment levee and existing shoreline which is typically too far from the shoreline to prevent other tidally influenced or wind-driven wave energies that contribute to erosion. While the land mass would delay a containment levee breach, without a breakwater in place, a breach is still likely given that historical imagery shows a breach in the containment levee in this semi-protected stretch as early as 1989 that appears to have been repaired multiple times since then. The marsh restoration would remain exposed to coastal forces and be less sustainable.

It was determined that the environmental benefits lost as a result of the one-mile reduction in breakwater were too significant in comparison to the potential cost savings achieved. The estimated reduction in breakwater costs was approximately $2.4M in FY21 price level 8and would not resolve the difference in cost between the original proposal and the TSP cost. Therefore, the original breakwater length is proposed in the recommended plan. The PDT also considered whether seeding instead of planting the marsh and living shoreline might reduce cost but determined that seeding creates an unacceptable risk of success for the restoration effort and planting is recommended.

10.2. Final Cost Estimate Revisions in Fiscal Year 22 (FY22) Price Level

The preliminary cost estimate presented in Section 6.0 was updated following internal quality reviews. The changes required an increase in the cost estimate for mobilization and demobilization, based on recent bids. The cost increases are reflected in Accounts 06 and 10 which impacted all alternatives. The updated project cost estimate is provided in Table 22 below, in FY 22 price level.

Table 22 -Updated TSP Cost FY22

Code of Accounts	*Alt 3 - 1.35 MCY + Living Shoreline+ Breakwater*
NON-FEDERAL COSTS	
01 Lands and Damages	161,000
Total Non-Fed	161,000
FEDERAL COSTS	
01 Lands and Damages	36,000
06 Fish & Wildlife Facilities	2,257,000
06 Living Shoreline	2,442,000
10 Breakwater and Seawall	19,468,000
12 Dredging	10,906,000
30 Planning, E&D	3,637,070
31 Construction Management	2,805,840
Total Federal Cost	$ 41,551,910
TOTAL PROJECT COST:	**$ 41,712,910**
TOTAL PROJECT COST (rounded)	**$ 41,713,000**

The cost estimates applied in the formulation screenings steps were developed with existing information to compare and screen alternatives in terms of cost, performance, and impacts. The plan formulation process was consistent with the Planning Modernization directive to complete high quality feasibility studies with shorter timeframes and lower costs. This process emphasizes early publication and receipt of comments before the recommended plan is fully refined to ensure that study costs are allocated for refining an alternative to incorporate technical, policy and public comments.

Future refinements between draft and final report or in Pre-Construction Engineering and Design (PED) phase will include operation and maintenance assumptions, the implementation and construction method, and the necessary scale of features based upon technical, policy and public comments.

11.0 Funding

Section 1122 implementation establishes the cost share among fed and Cost shared elements. Dredging and incremental cost for delivering the material to the project site is eligible for 100% federal funding. Additional project components will require cost share. Fringe plantings are proposed for interior marsh restoration to achieve ecosystem goals at a lower relative cost than planting the entire site.

Section 1122 implementation establishes the cost share among 100% Fed and Cost shared elements:

- Dredging found to be in the federal interest is 100% federal cost
- Dredging in excess of depth found to be in the federal interest is Cost Shared
- Marsh construction, living shoreline, plantings-Cost shared
- Breakwater-Cost Shared

The non federal sponsor cost share will be determined by the cost of dredging any incremental volumes of sediment to achieve marsh restoration. At this time, the Galveston District proposes that dredging to the authorized channel depth is not in the best interest of the government due to depth limited interior channels. As a result, dredging costs to acquire the necessary marsh restoration volumes would be cost shared consistent with the Section 1122 implementation guidance, 65% federal and 35% non-federal. The non-federal sponsor has expressed support for the largest scale of marsh restoration as proposed within Alternative 3 and has confirmed its ability to cost share the effort. Table 23 presents the range of potential dredging depths and associated cost share scenarios. The cost share for the living shoreline and breakwater are not dependent upon the dredging volume and are presented separately. The NFS cost-share for the breakwater, not including construction management costs, is approximately $6.83M, and the federal share for the breakwater, not including construction management costs, is approximately $12.7M. The NFS cost-share for the living shoreline, not including construction management costs, is approximately $875,000, and the federal share for the living shoreline, not including construction management costs, is approximately $1.7M.

Table 23 - Potential Cost Share and Federal Dredging Depth Scenarios

Scenario	**Dredging Cost**		**Marsh**			**TOTAL Fed**	**TOTAL NFS**
	Fed	NFS	Total	Fed .65	NFS .35		
1.3M CY Fed Action: 31’	11.9 M	0	2.6 M	0	922,000	14.5 M	3.5 M
500,000 CY Fed Action: 26’ depth	5.4 M	0	1.7 M	0	600,000	7.1 M	600,000
1.3M CY Fed Action: 26’	5.4 M 4.2 M	2.3 M	2.6 M	1.1 M	922,000	10.7 M	3.1 M

12.0 Innovative Nature Consistent with Section 1122 Implementation Guidance

The Hickory Cove project is innovative in nature because it fosters creation of BU opportunities for sediment produced through O & M dredging in the region. The partnership effort includes the technical restoration experience of Ducks Unlimited and an area landowner to restore emergent marsh habitat in the region over several cycles of dredging and support continued O&M dredging actions through the creation of a placement area alternative. The collaborative effort of the Port of Orange, DU and a private land owner demonstrate that restoration alternatives may meet the placement area needs in a region while sustaining valuable habitat.

13.0 Recommendation

I concur with the findings presented in this report. The recommended plan is technically sound, economically justified, and socially and environmentally acceptable. Accordingly, I recommend that BU at the proposed location be authorized in accordance with the reporting officers' recommended plan with such modifications as in the discretion of the Chief of Engineers may be advisable.

Alternative 3 is recommended as the Tentatively Selected Plan, which achieves objectives and reasonably maximizes costs. Alternatives 1 and 2 are cost effective scales that restore marsh and maintain the marsh over time, but Alternative 3 maintains the marsh and achieves maximum AAHUs with reasonable incremental cost over the period of analysis. This alternative has been demonstrated to be cost effective through consideration of ecological lift achieved for cost of implementation. The construction of a breakwater to reduce erosion adjacent to marsh restoration sites is a recognized best practice for sustainable restoration along the Texas Coast. Implementation is proposed for 2023 when the dredging of the channel is proposed within the District workplan.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels with the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorizations and implementation funding. However, prior to transmittal to the Congress, the NFS, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

____
Date

____
Timothy R. Vail
Colonel, U.S. Army
Commanding

* Final Report To be signed

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Hickory Cove Marsh Restoration And Living Shoreline

Bridge City, TX

WRDA 2016 Section 1122

Beneficial Use of Dredged Material

Appendix A: Engineering

U.S. Army Corps of Engineers

Southwest Division

Galveston District

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1 INTRODUCTION

1.1 Study Overview and Purpose

The Hickory Cove Marsh Restoration and Living Shoreline Beneficial Use of Dredged Material (BUDM) pilot project is a partnership between the U.S. Army Corps of Engineers (USACE), Galveston District and the Port of Orange, Texas. The project is intended to demonstrate the beneficial use of dredged material to address ecosystem-related problems in the Hickory Cove study area and identify a plan that ultimately improves, preserves, and sustains ecosystem resources.

Texas is estimated to have lost approximately 210,590 acres of coastal wetlands from the mid-1950's to early 1990's (Ducks Unlimited, 2013). The ecosystem functions and values provided by these habitats are crucial to support critical waterfowl and coastal fish habitat, and reduce storm damage to property and infrastructure and provide recreational opportunities for the neighboring communities. Identified problems specific to Hickory Cove include marsh loss from wave action, subsidence, sea level rise, insufficient sediment supply, and increased salinity resulting in marsh habitat conversion from freshwater or intermediate marsh to saltwater marsh. The priority to protect and restore the habitat of Hickory Cove is recognized within the Chenier Plains Initiative Area, by the Gulf Coast Joint Venture Initiative Areas effort (Ducks Unlimited, 2013). The purpose of this study is to characterize the problems and identify solutions in support of BUDM and preservation of ecosystem resources at Hickory Cove, consistent with regional conservation programs.

1.2 Study Authority

This study was conducted under the authority of Section 1122 of the Water Resources Development Act (WRDA) of 2016 which requires USACE to pursue pilot demonstrations of the beneficial use of dredged material (BU). The projects studied and implemented under this authority should serve the purpose of using dredged material for the purposes of –

(1) Reducing storm damage to property and infrastructure;

(2) Promoting public safety;

(3) Protecting, restoring, and creating aquatic ecosystem habitats;

(4) Stabilizing stream systems and enhancing shorelines;

(5) Promoting recreation;

(6) Supporting risk management adaptation strategies; and

(7) Reducing the costs of dredging and dredged material placement or disposal, such as projects that use dredged material (USACE, 2018).

1.3 Study Area

The project is located within Hickory Cove Bay and is located adjacent to the Sabine River and the northern end of Sabine Lake (Figure 1). The focused study area includes 677.31 acres of marsh with the potential to be restored from open water to freshwater marsh habitat dependent on sediment availability. The land is owned and operated by the Hawk Club and adjacent to the Lower Neches Wildlife Management Area, which is owned and operated by Texas Parks and Wildlife Department (TPWD). There are two federal navigation projects in or near the study area including the Sabine River and the Gulf Intercoastal Waterway (GIWW). Sabine Lake is a lake estuary situated in the southeast corner of Texas, along the border of Texas and Louisiana.

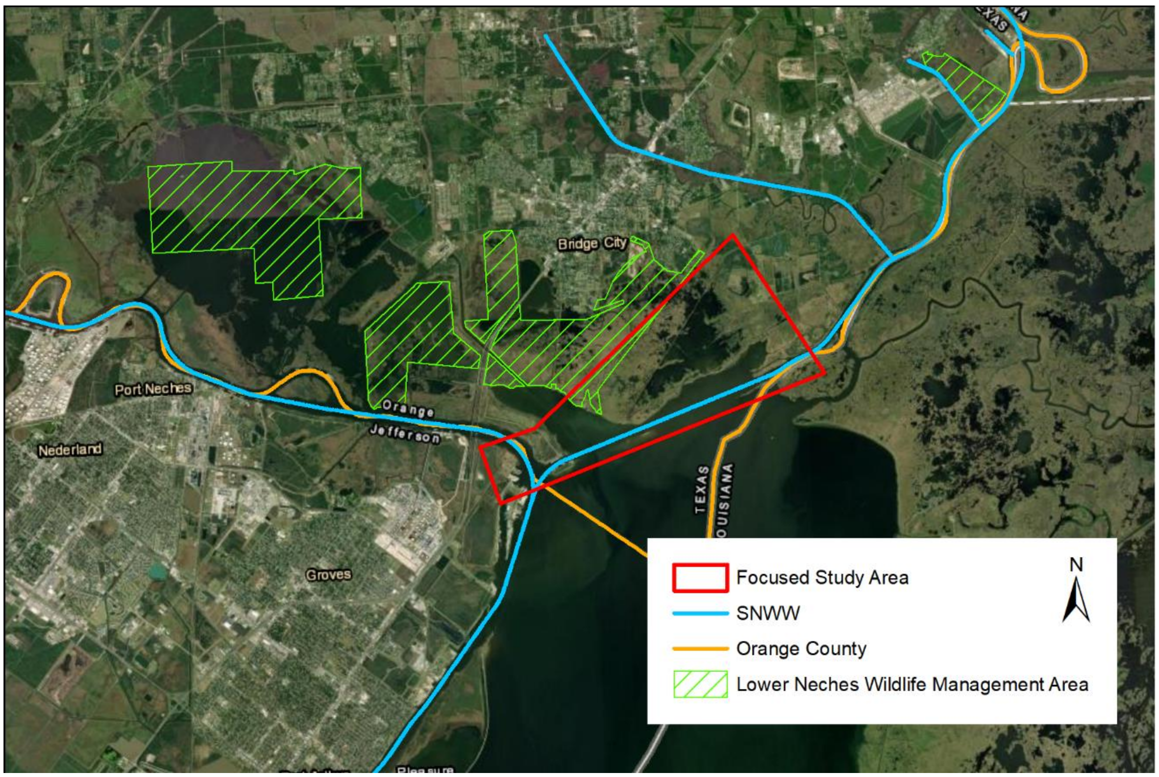

Figure 1. Hickory Cove Marsh Restoration and Living Shoreline Section 1122 Feasibility Study Area

1.4 Overview of other Ecosystem Restoration (ER) Projects

Other agencies have undertaken marsh restoration measures by beneficially using dredged material to restore habitat near the study area. Texas Parks and Wildlife Department (TPWD) cooperated with the Port of Orange and local private industry to restore habitat to support emergent wetland plants at Old River Cove in the Lower Neches Wildlife Management area adjacent to Hickory Cove as shown in Figure 2.

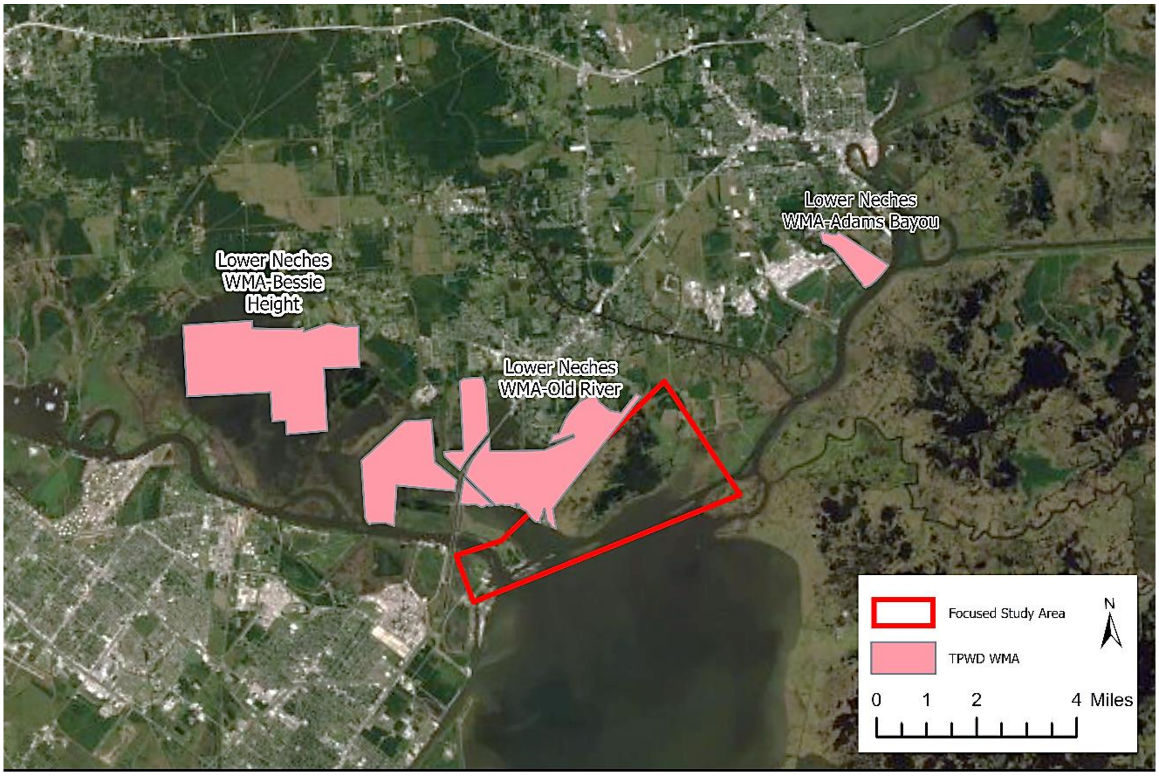

Figure 2. Wildlife Management Areas near the Study Area

2 ALTERNATIVES

2.1 Focused Alternatives Array

An initial suite of alternatives was generated to assess the viability of the pilot study proposal, based on formulation strategies informed by project goals and study area conditions. Preliminary screening identified alternatives that could beneficially use dredge material on site to assess which most completely addressed the problems and objectives identified. The alternatives considered, apart from no action, were incremental actions that built upon one another to beneficially use dredge material for effective and sustainable marsh restoration. Due to the uncertainty associated with available dredge material quantities, a range of potential volumes and areas associated with each were considered and are summarized in Table 1 and presented as subsets of each alternative described thereafter. The marsh modification area reflected in figures 3 through 6 represents the open water areas with potential to restore. Alternatives that add a breakwater and living shoreline summarized in this section are assumed to be compatible with varying quantities of material, assuming material quantity is minimally sufficient for the containment levee repairs. Unless otherwise noted, all elevations are relative to NAVD88 vertical datum.

Table 1. Range of Alternative Subsets and their Associated Marsh Restoration Area

	Alternative Subset	***a***	***b***	***c***	***d***
	Range Upper Limit (CY)	***500K***	***900K***	***1.3M***	***1.5M***
Sediment Quantities	**Area (acres)**	68	126	190	213
	Marsh Restoration (CY)	468,000	867,000	1,310,000	1,470,000
	Training Berm Length (LF)	5,900	13,360	16,000	16,410
	Training Berm Quantity (CY) H = 5.5 FT	27,940	63,200	75,700	77,640
	Containment Levee Restoration (CY) (earthen, in situ matl source)	28,644	28,644	28,644	28,644
	Total (CY)	**496,644**	**895,644**	**1,338,644**	**1,498,644**

The array of alternatives include:

No Action: traditional placement of dredge material into placement areas 29A/B (fig 3).

Alternative 1: This alternative focuses on restoring marsh to a target elevation for vegetation establishment utilizing dredged material. It will also restore an existing but breached privately owned containment dike (fig. 4).

Alternative 2: This alternative builds upon Alternative 1 and includes shoreline protection to ensure sustainability of the marsh. It restores the existing but breached containment dike, restores marsh habitat and constructs a 14,623 LF detached breakwater system to attenuate waves along the SNWW/GIWW (fig 5).

Alternative 3: This alternative builds upon Alternative 2 with additional shoreline protection between the containment levee and the breakwater through implementation of a living shoreline. It restores the existing but breached containment dike, marsh habitat, plants a living shoreline on the exterior side of the containment levee and constructs a 14,623 LF detached breakwater system to attenuate waves along the SNWW/GIWW (fig. 6).

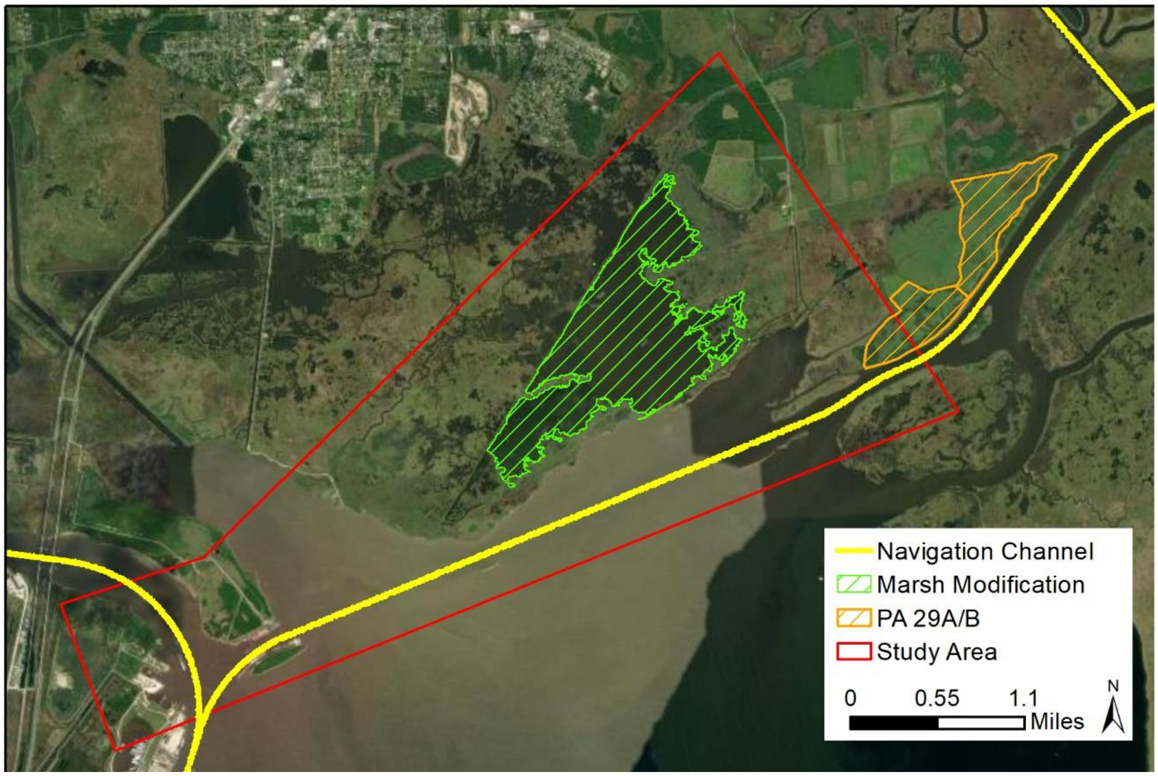

Figure 3. Hickory Cove no action plan, placement areas 29A/B

Figure 4. Hickory Cove Alternative 1

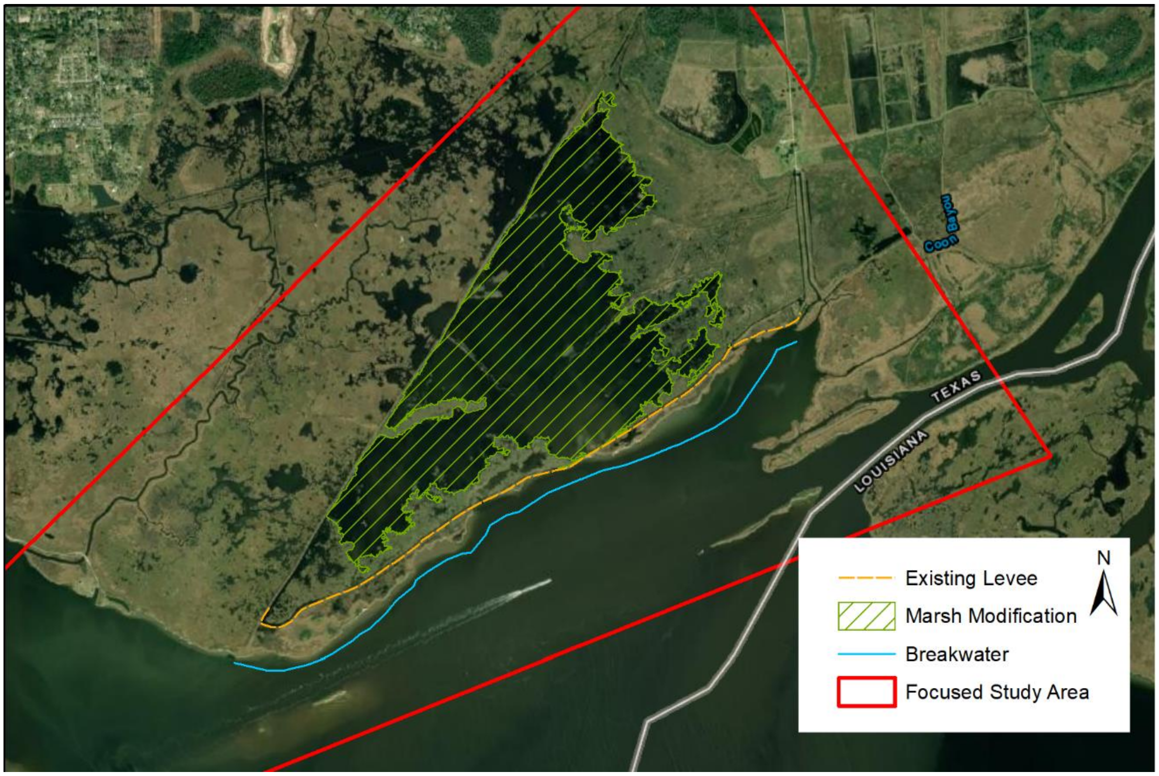

Figure 5. Hickory Cove Alternative 2

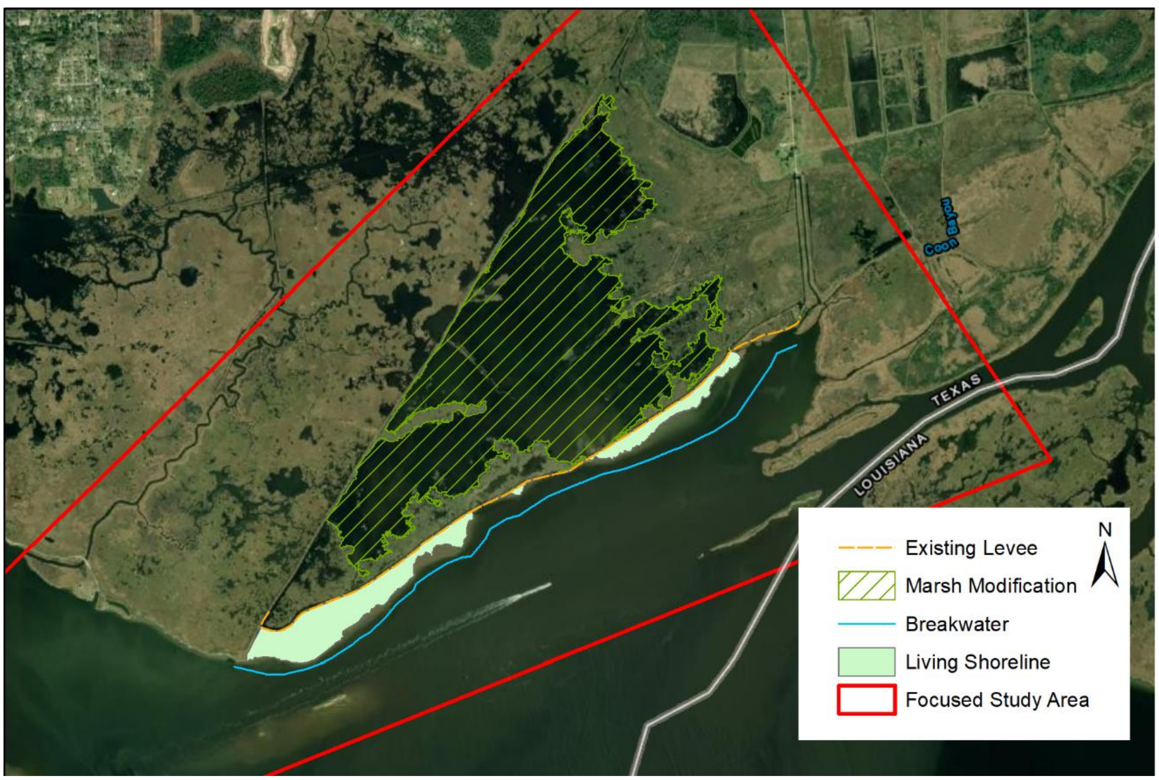

Figure 6. Hickory Cove Alternative 3

2.2 Alternatives Evaluation and Comparison

The quantities and costs for each alternative were developed using feasibility-level analysis. Available existing data, engineering assumptions and professional judgment were leveraged to develop the alternatives but should be revisited during Design and Implementation (D&I) and/or as new information becomes available. The actual acreage of marsh to be restored depends on sediment availability, the expected ranges are outlined in Section 6.2 and confirmed quantities in Section 7.

3 HYDRAULICS AND HYDROLOGY

3.1 Tidal Datum and Vertical Datum

Tidal datums are base elevations used to predict heights and depths. These datums are determined by statistical analysis of long-term water surface measurements. The U.S. National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services (CO-OPS) maintains ocean observing infrastructure that includes the permanent water level stations closest to the study area as shown in Figure 7.

Figure 7. NOAA permanent tide gages near the study area

3.2 Hydrology

Drainage in and around the study area is driven by the Sabine River to the east of Hickory Cove and the Neches River to the west. Overland flow from the area north of the Hickory Cove (i.e. Bridge City) contributes to freshwater drainage into the study area as it exists today with a contributing drainage area of 7,120 acres. From the outlet of the Neches and Sabine rivers into Sabine Lake, Sabine Pass connects the estuary lake to the Gulf of Mexico. The USGS hydrologic units, streams and waterbodies are shown in Figure 8 and USGS stream gages in and around the study area are shown in Figure 9.

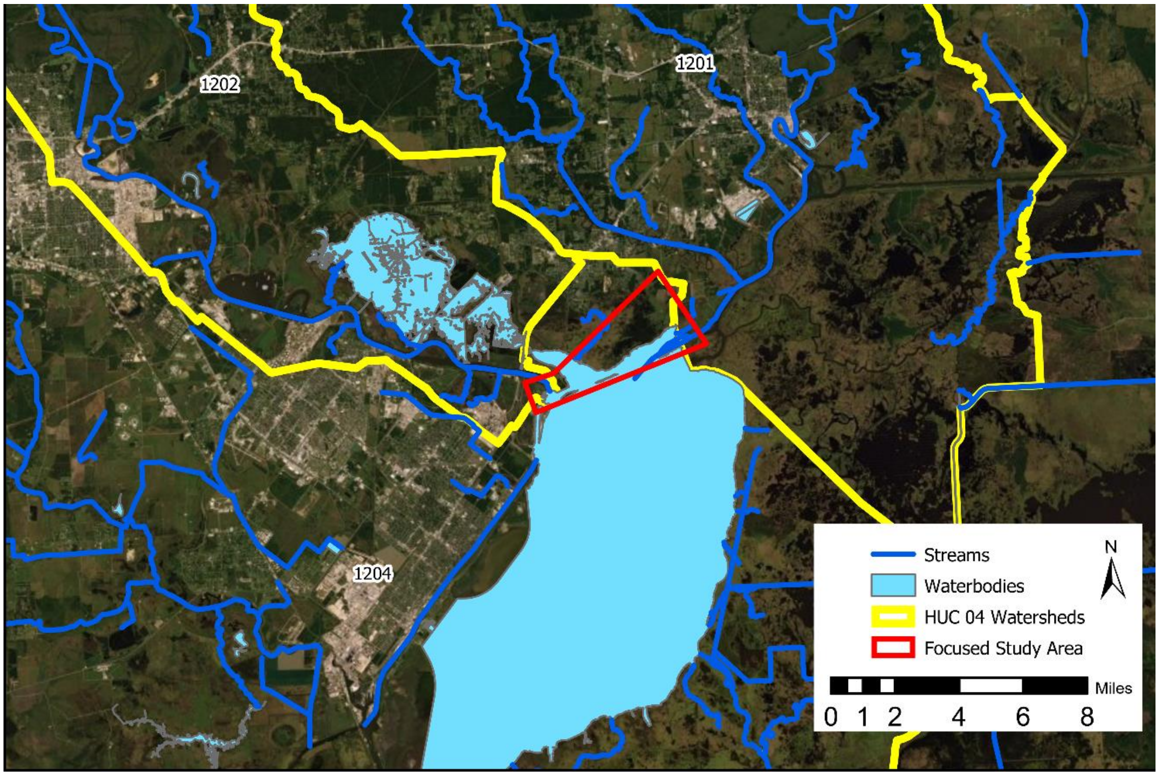

Figure 8. USGS Rivers, Streams and Waterbodies in and around the study area

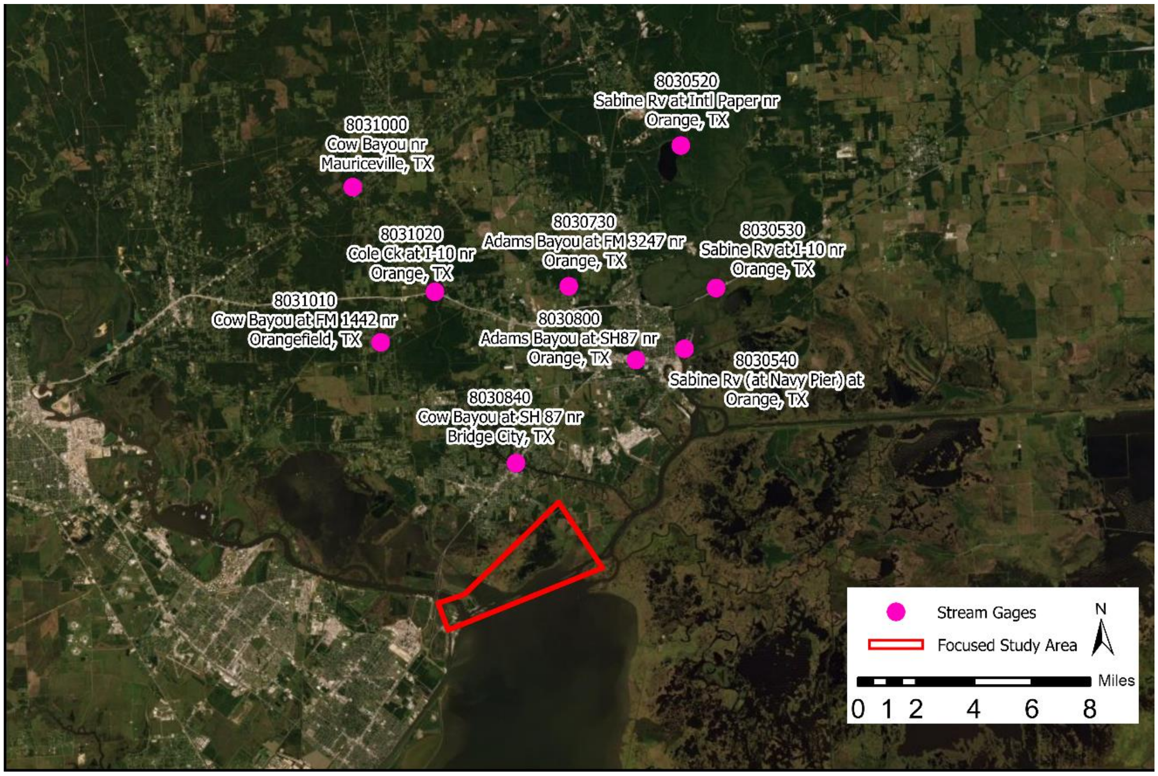

Figure 9. USGS Stream Gages near the study area

3.3 Climate Change

The western Gulf Coast is projected to experience greater sea level rise driven by climate change than the global average for almost all future global mean sea level rise (GMSL) scenarios. The impacts of future rising sea level concerns (RSLC) with respect to USACE projects is addressed using guidance from ER 1100-2-8162 (USACE, 2013) and ETL 1100-2-1 (USACE, 2014). The nearest tide gauge available for SLR analysis is 8770570 Sabine Pass North, TX shown in Figure 7. The USACE Sea Level Change Curve calculator (2019.21) was utilized to investigate expected SLR through the design life of 50 years with project construction tentatively expected to occur in 2023. The estimated RSLC curves are shown in Figure 10 and shown in Table 2. The intermediate mean sea level change is estimated at 1.72-ft NAVD88 for 2073. The high and low change to the mean sea level for the same year is 3.57-ft and 1.13-ft NAVD88 respectively. Figure 11 shows the expected inundation (MHHW) in and around the study area in Orange County from +2 feet of RSLC (NOAA/OCM, 2017c).

Table 2. USACE RSLC Results for NOAA Tide Gauges 8770570, Sabine Pass North, TX (NAVD88)

Year	Low	Int	High
2010	-0.04	-0.01	0.08
2015	0.06	0.10	0.25
2020	0.15	0.22	0.44
2025	0.24	0.34	0.65
2030	0.34	0.46	0.87
2035	0.43	0.59	1.11

2040	0.52	0.73	1.38
2045	0.61	0.86	1.66
2050	0.71	1.01	1.95
2055	0.80	1.15	2.27
2060	0.89	1.30	2.61
2065	0.99	1.46	2.96
2070	1.08	1.62	3.33
2075	1.17	1.78	3.73
2080	1.26	1.95	4.14
2085	1.36	2.13	4.56
2090	1.45	2.30	5.01
2095	1.54	2.49	5.48
2100	1.64	2.67	5.96

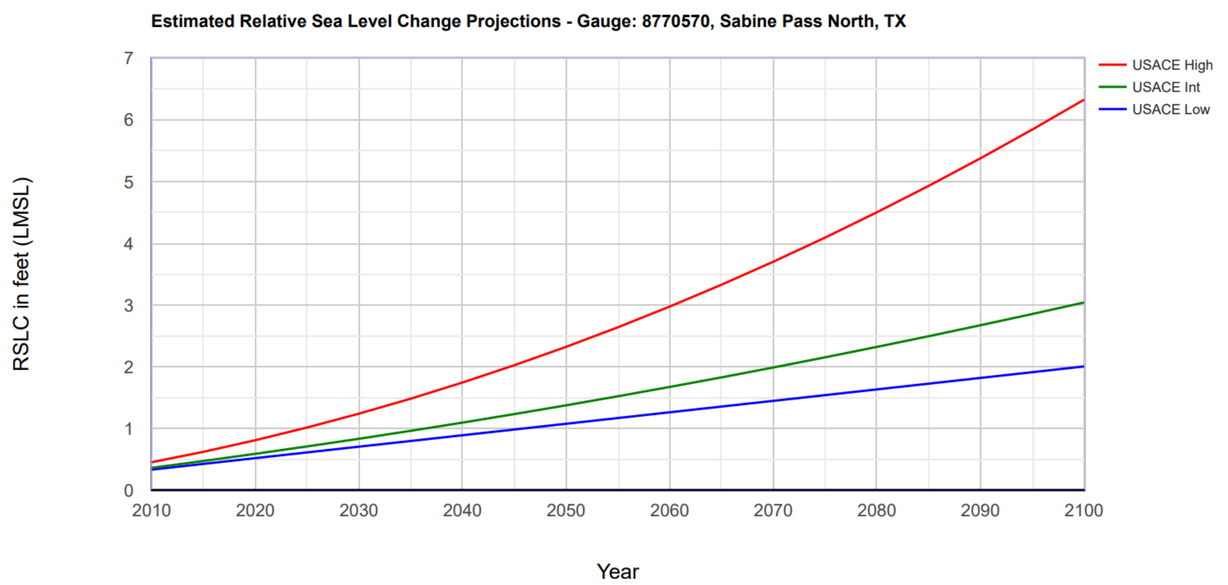

Figure 10. USACE predicted RSLC low, intermediate, and high curve

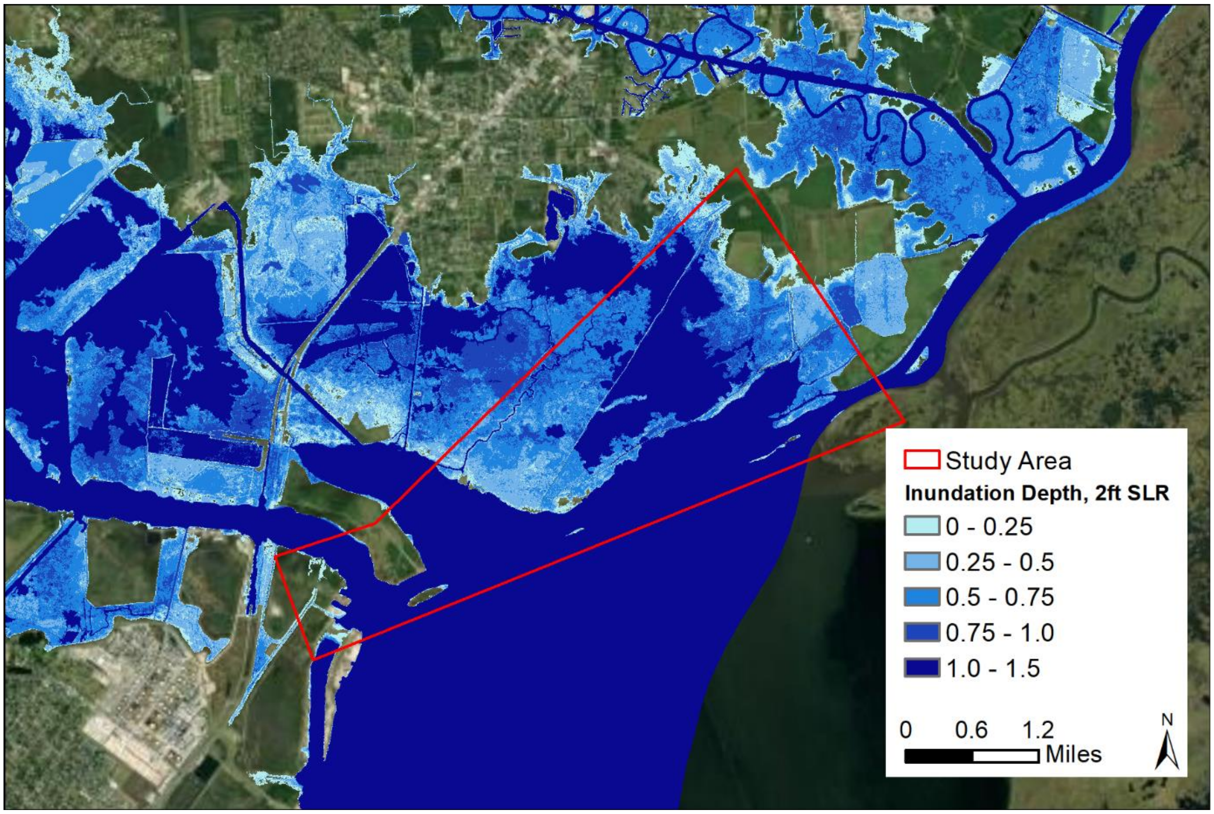

Figure 11. Overview of additional inundation (MHHW) from 2.0 ft. of RSLC in Orange County, TX based on 2010 LULC and 2019 regional LiDAR (NOAA/OCM, 2019)

3.4 Coastal Processes

3.4.1 Tides

The tides at gage 8770520 are indicative of tides nearest Hickory Cove for the purposes of this study. This assumption may be revisited in the Design and Implementation (D&I) phase if needed as the study area is located at the northern boundary of Sabine Lake and the specified tide gage is further west at the mouth of the Neches River as shown in Figure 7.

3.4.2 Currents, Circulation, Salinity

Sabine Pass is a jettied inlet for the deep-draft SNWW that connects the Gulf of Mexico to Sabine Lake at the southern tip of the lake. Freshwater is brought to the system primarily from the Sabine and Neches Rivers. Tidal action impacts the study area predominantly through Sabine Lake due to multiple breaches in the containment dike caused by erosion due to wave action. When the containment levee is intact there is minimal tidal influence on the marsh allowing for appropriate conditions for emergent freshwater marsh habitat as is currently successful in the Lower Neches Wildlife Management Area just west of Hickory Cove.

3.4.3 Storm History

Two types of meteorological events that have major impacts on the landscape are precipitation events and/or storm surge events, i.e. hurricanes. These higher energy events can cause shoreline erosion and flooding through elevated water levels and erosive waves. These phenomena impact both natural and man-made shoreward infrastructure including transportation facilities, buildings, and navigation channels.

While the damage inflicted by these tropical storms and hurricanes can be catastrophic, they are relatively infrequent. The history of coastal storms around the study area are presented in Table 3 and their respective storm tracks shown in Figure 12.

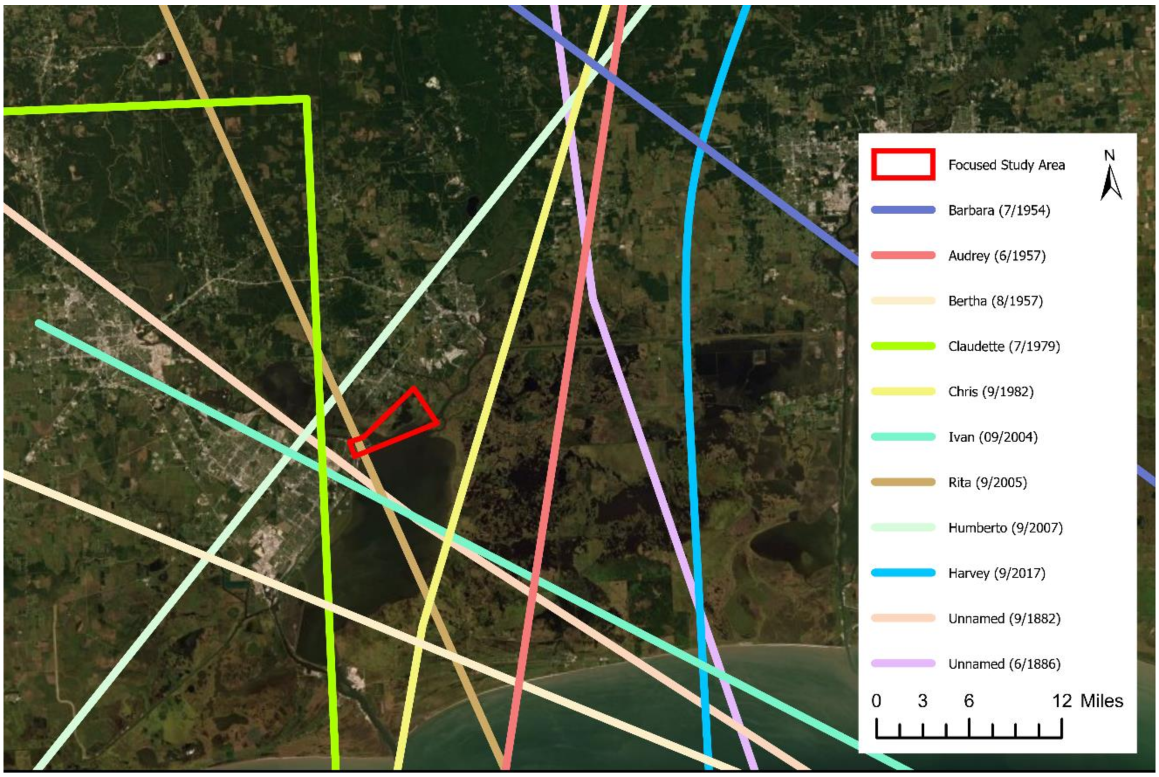

Figure 12. Select historical storm tracks in and around the study area

Table 3. Historical Storms near the Study Area

					Conditions at Landfall	
Date	**Type**	**Name**	**Latitude**	**Longitude**	**Max Wind (kts)**	**Min. Central Pressure (mb)**
August 1879	Hurricane	No Name	29.6	-94.2	90	964
June 1886	Tropical Storm	No Name	29.6	-94.2	85	-
October 1886	Hurricane	No Name	29.8	-93.5	105	-
October 1895	Tropical Storm	No Name	29.3	-94.8	35	-

September 1897	Hurricane	No Name	29.7	-93.5	75	-
September 1898	Tropical Storm	No Name	29.4	-94.7	50	-
Aug-40	Hurricane	No Name	29.7	-94.1	85	972
Sep-40	Tropical Storm	No Name	29.8	-93.4	40	-
Sep-41	Tropical Storm	No Name	29.6	-94	30	1006
Aug-42	Hurricane	No Name	29.5	-94.6	65	-
Jul-43	Hurricane	No Name	29.5	-94.6	90	967
Sep-46	Tropical Storm	No Name	29.7	-93.8	25	-
Jul-54	Tropical Storm	Barbara	29.7	-92.8	50	999
Jun-57	Hurricane	Audrey	29.8	-93.7	110	946
Aug-57	Tropical Storm	Betha	29.7	-93.9	55	998
Jul-59	Hurricane	Debra	29.1	-95.2	75	980
Sep-63	Tropical Storm	Cindy	29.8	-94.4	65	997
Sep-70	Tropical Storm	Felice	29.4	-94.1	60	997
Sep-71	Hurricane	Edith	29.5	-93.1	85	978
Aug-78	Tropical Storm	Debra	29.6	-93.6	50	1000
Jul-79	Tropical Storm	Claudette	29.6	-93.9	45	1000
Sep-80	Tropical Storm	Danielle	29.4	-94.9	40	1004
Sep-82	Tropical Storm	Chris	29.8	-93.8	55	994
Jun-86	Hurricane	Bonnie	29.6	-94.2	75	990
Jun-89	Tropical Storm	Allison	28.7	-95.2	40	1002
Jul-89	Tropical Storm	Chantal	29.6	-94.2	75	990
Oct-89	Hurricane	Jerry	29.2	-95	75	983
3-Aug	Tropical Storm	Grace	29.4	-95.1	35	1007
4-Sep	Hurricane	Ivan	29.8	-93.6	30	1004
5-Sep	Hurricane	Rita	29.7	-93.7	100	937
7-Sep	Hurricane	Humberto	29.6	-94.3	80	985
8-Aug	Tropical Storm	Eduardo	29.6	-94.2	55	996
8-Sep	Hurricane	Ike	29.3	-94.7	95	950

3.4.4 Wave Climate

Wave characteristics available nearest the study area include Wave Information Study (WIS) hindcasts compiled by USACE ERDC-CHL and direct measurements collected as part of the National Data Buoy Center (NDBC) network (NOAA/NWS, 2017c). The available data included in the WIS hindcasts includes wave information for the Gulf of Mexico south of Sabine Lake, south of Sabine Pass, and would not be representative of wave conditions at the project site.

The USACE Wind Information Studies website was utilized to characterize wind conditions nearest the project site as shown in Figure 13. The wind rose from Station 73088 was referenced, shown in Figure 14, to determine that the dominant wind direction is from the southeast while the least frequent is from the west.

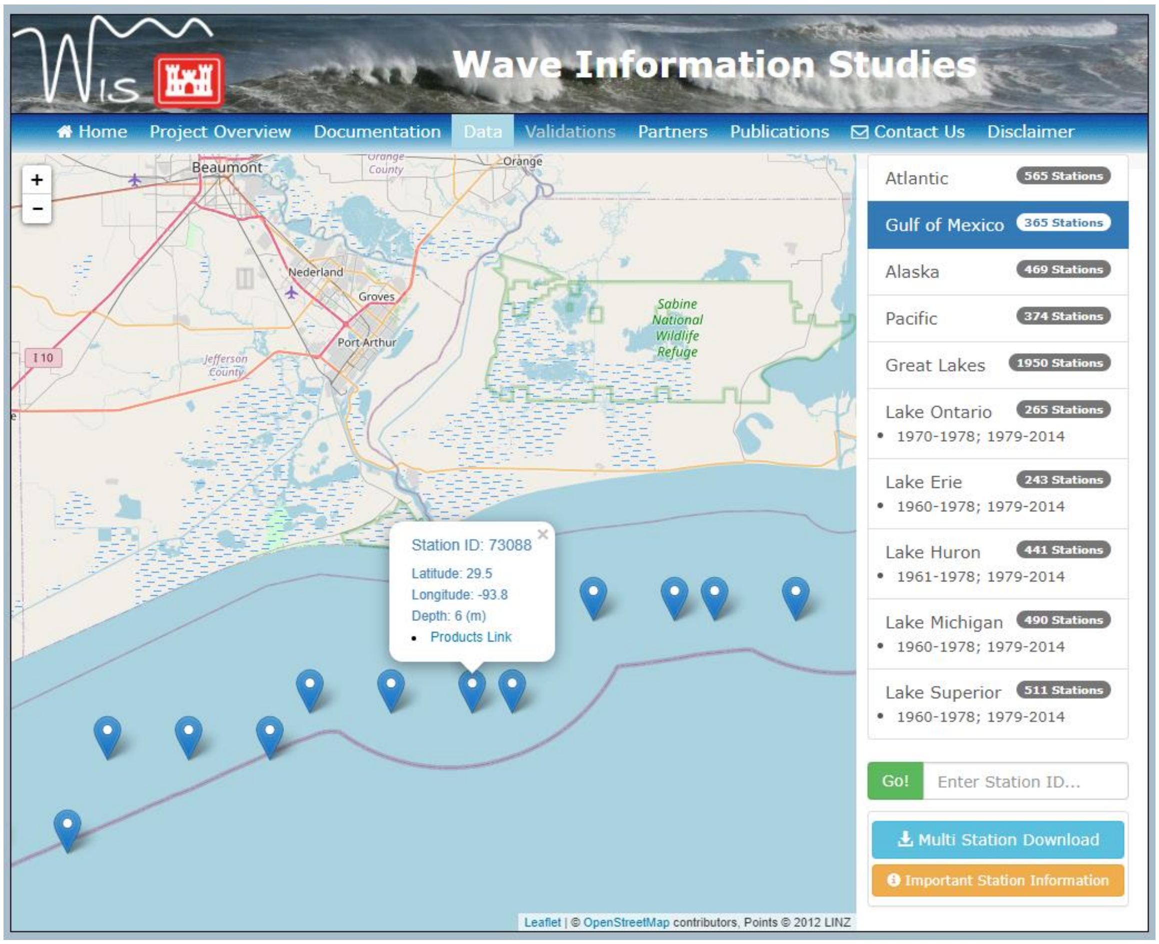

Figure 13. WIS Station 73088 Location

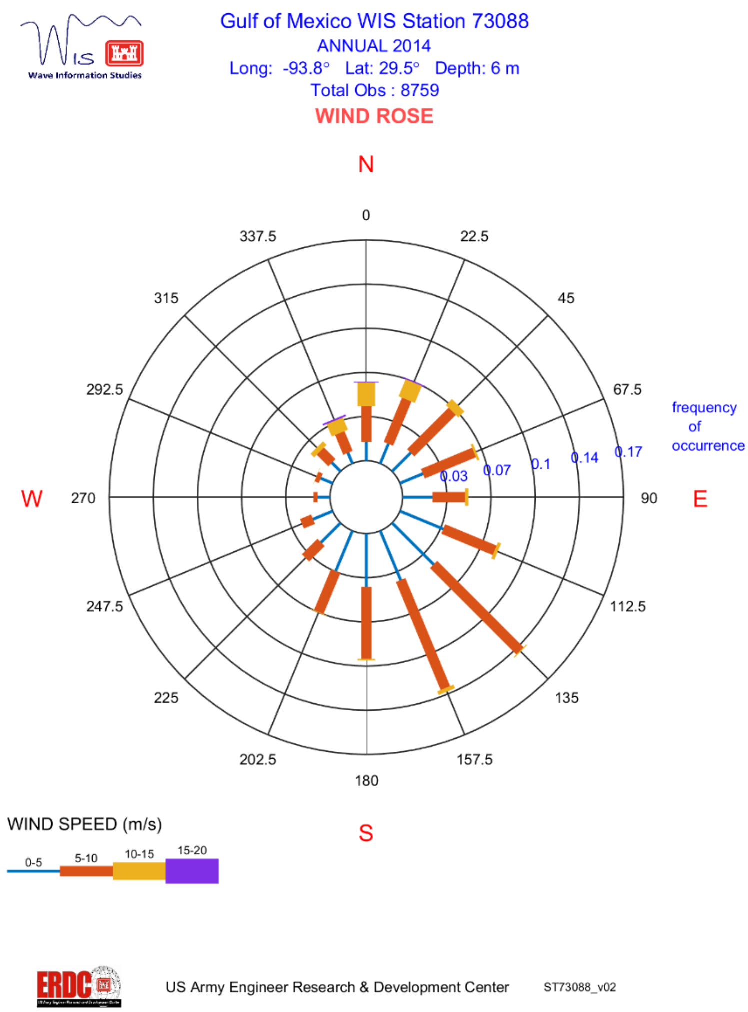

Figure 14. WIS Station 73088 Wind Rose

3.4.4.1. Ship-Induced Waves

The AISAP portal was utilized to identify vessel traffic in the study area along the SNWW/GIWW in front of Hickory Cove Bayas summarized in figure 15 (http://ais-portal.usace.army.mil/). Most of the vessel traffic consists of towing vessels. The average vessel speed is 5.86 knots with the larger vessels traveling between 3.5 and 7 knots. There were 1415 transits over this 30-day period of analysis, approximately 47 per day. The most conservative case is the Fritz vessel with a max speed of 4.2 knots, draft of 83.7-ft, length of 105-ft and width of 32.8-ft. Using the USACE developed Ship Induced Wave Analysis spreadsheet and methodology from The Rock Manual (CIRIA, 2007) the front wave height is computed as 3.77-ft and the maximum secondary wave height computed as 0.07-ft with a 2.3-s period. The maximum stern wave height was computed as 5.15-ft.

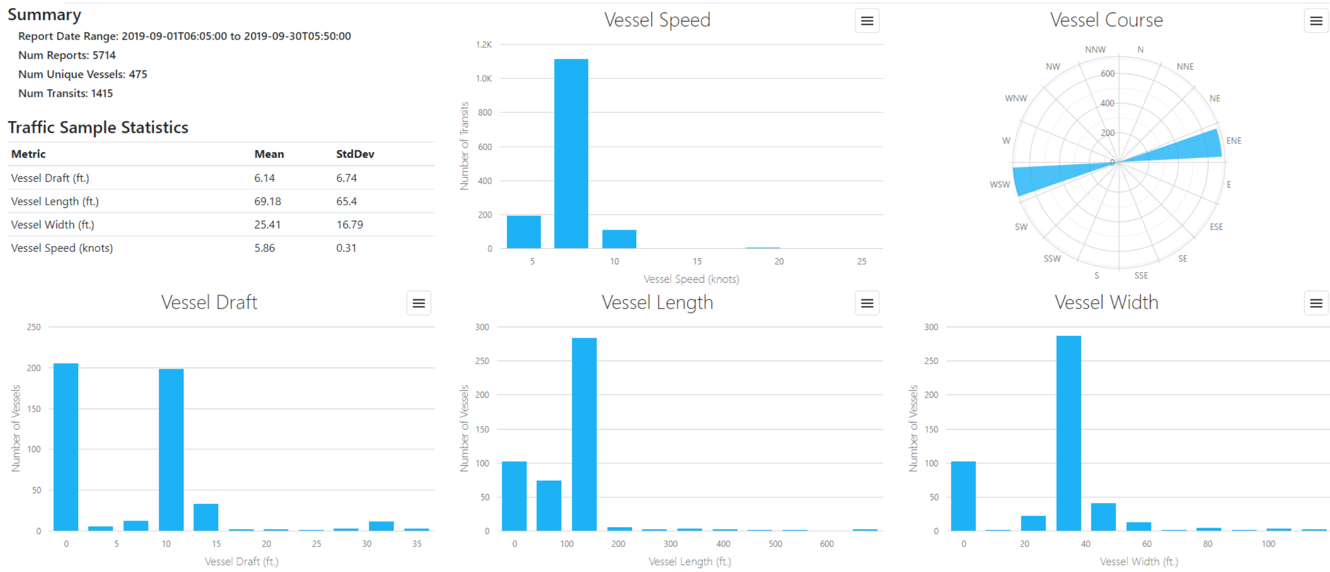

Figure 15. Summary Statistics for SNWW/GIWW Section adjacent to Hickory Cove Shoreline (September 2019)

3.4.4.2. Wind-Driven Waves

The wind-driven waves are computed based on the design wind speed. The ASCE 7 Hazard tool (fig. 16) (https://asce7hazardtool.online/) was utilized to determine the 10-year, 3 second gust design speed at 33-ft to be 77 mph for Exposure C Category II. Based on Figure 17, the Durst Gust-Factor conversion for 3-sec winds is 1.53. The 10-year sustained winds are 50.3 mph.

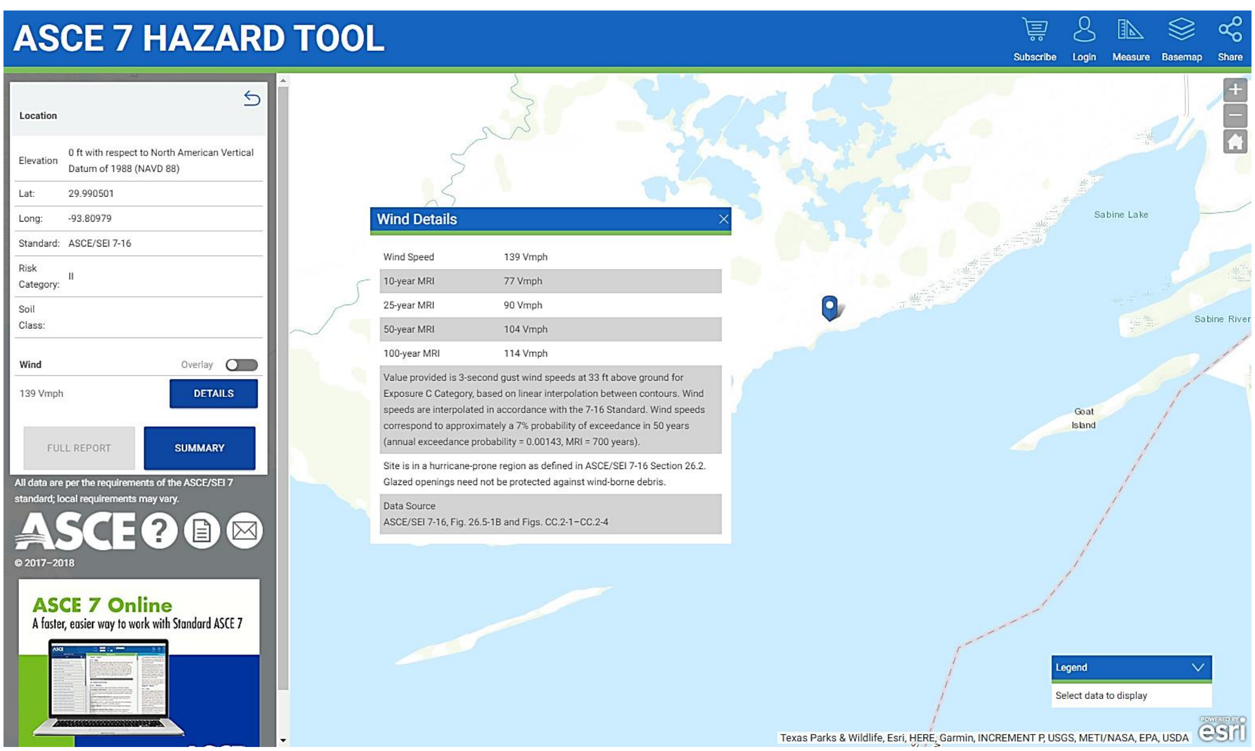

Figure 16. ASCE 7 Wind Hazard Tool

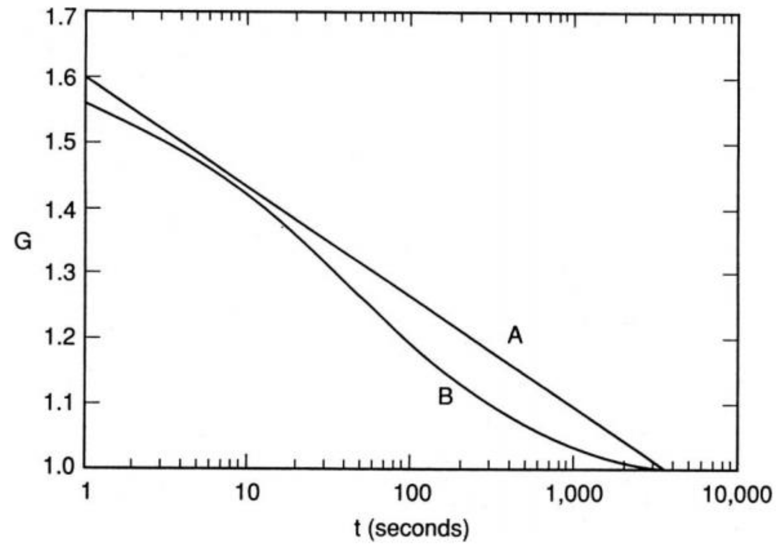

FIG. 1. Gust factors based on hourly mean wind speed ($z = 10$ m, $z_o = 0.03$ m). Curve "A" (Cook 1985) is a simplified representation of gust factors, and is used for structural design in the United Kingdom, while curve "B" (Durst 1960; ASCE 1990) is used in the United States.

Figure 17. Durst Gust-Factor Conversion (Krayer & Marshall, 1992)

The CEDAS/ACES program was used to compute fetch-generated waves for the 10-year return period. The fetch was determined by fetch lines drawn at 15-degree intervals as shown in Figure 18. The wind direction and latitude of observation is specified as 157.5-degrees and 29.5-degrees respectively based on the wind rose in Figure 14. The average fetch depth of 10.45-ft is based on the 6-ft MLLW average depth of Sabine Lake (NOAA/OCS, 2020) the intermediate predicted SLR of 2.06-ft MSL, the difference between MLLW and MSL of 0.96-ft and the stillwater depth of 4.13-ft for the 10-year storm (FEMA, 1997). This resulted in a predicted wave height of 3.08-ft NAVD88 (3.21-ft MSL) and a wave period of 3.39-sec as summarized in Figure 19.

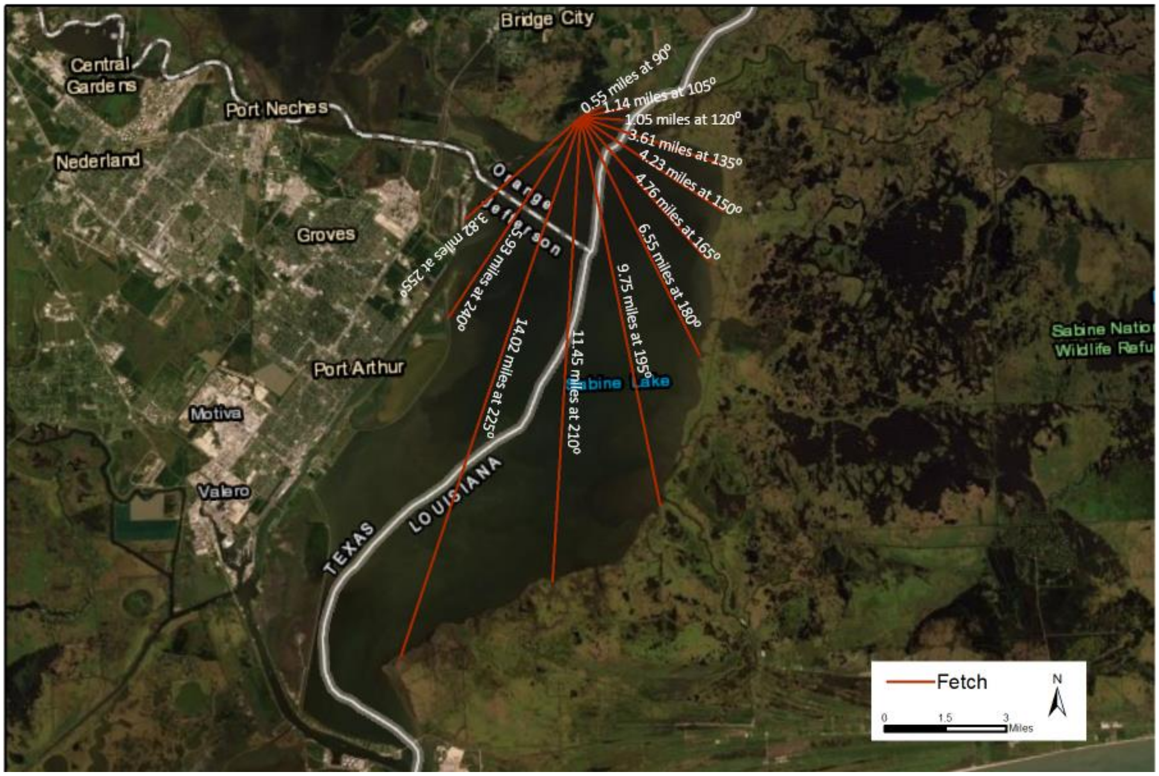

Figure 18. Fetch angles and distances across Sabine Lake

Case: 10-Year Storm

Windspeed Adjustment and Wave Growth

Breaking criteria 0.780

Item	Value	Units
El of Observed Wind (Zobs)	33.00	feet
Observed Wind Speed (Uobs)	50.30	mph
Air Sea Temp. Diff. (dT)	0.00	deg F
Dur of Observed Wind (DurO)	12.00	hours
Dur of Final Wind (DurF)	12.00	hours
Lat. of Observation (LAT)	29.50	deg
Results		
Wind Fetch Length (F)	9.22	MILES
Avg Fetch Depth (d)	10.45	feet
Wind Direction (WDIR)	157.50	deg
Eq Neutral Wind Speed (Ue)	45.27	mph
Adjusted Wind Speed (Ua)	65.70	mph
Mean Wave Direction (THETA)	193.00	deg
Wave Height (Hmo)	2.89	feet
Wave Period (Tp)	3.47	sec

Wind Obs Type	Wind Fetch Options
Shore (windward)	Shallow restricted

Restricted Fetch Geometry

#	Fetch Angle (deg)	Fetch Length (miles)
1	90.00	0.55
2	105.00	1.14
3	120.00	1.05
4	135.00	3.61
5	150.00	4.23
6	165.00	4.76
7	180.00	6.55
8	195.00	9.75
9	210.00	11.45
10	225.00	14.02
11	240.00	5.93
12	255.00	3.82

Wave Growth: Shallow

Figure 19. CEDAS/ACES output for 10-year fetch based wave growth

3.5 Shoreline Change

The shoreline of Hickory Cove Bay has eroded due to the wave climate exacerbated by navigation traffic and wind waves generated across Sabine Lake Estuary. While some isolated areas have accreted or remained generally intact, much of the shoreline has experienced significant loss. The General Marsh Model, a decision support tool developed by Ducks Unlimited (2013), identified Hickory Cove bay as a high and medium priority candidate for shoreline protection. Aerial imagery was utilized to demonstrate the shoreline change from 1989 to 2019, as shown in Figure 20. Consistent with the General Marsh Model results shown in Figure 21, the central exposed region of the shoreline has eroded significantly to the point that the containment levee surrounding the marsh has been breached in multiple locations.

Figure 20. Shoreline Change from 1989 to 2019 at Hickory Cove based on Aerial Imagery

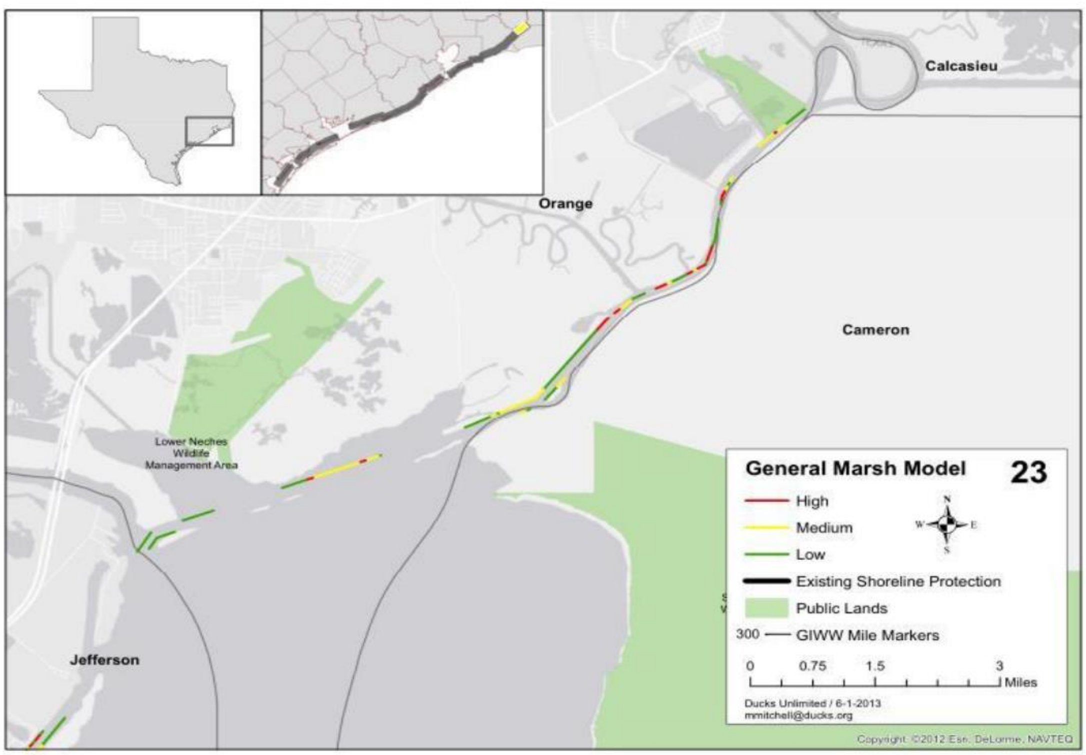

Figure 21. General Marsh Model results along GIWW for Hickory Cove (Ducks Unlimited, 2013)

4 SURVEYING, MAPPING AND OTHER GEOSPATIAL DATA

New and existing surveys were utilized to evaluate the array of alternatives. Ducks Unlimited provided survey data collected in 2018 for the containment levee and hydrographic survey data for the inundated nearshore region where the detached breakwater would be located. New hydrographic survey data was collected in November of 2019 and processed by SWG Geospatial Branch for the marsh interior as shown in Figure 23. This survey data characterized the depth of the inundated area of the marsh to be filled to the target elevations. The target elevations were informed by newly collected survey data in August of 2019 at Old River Cove restoration site, within the Lower Neches Wildlife Management Area just west of Hickory Cove, in cooperation with Texas Parks and Wildlife (TPWD). These elevations were shown to be successful at the Old River Cove site for establishing the appropriate vegetation to reestablish the freshwater marsh.

The following is an overview of the geospatial and physical data available in and around the study area:

- Aerial Imagery from 2019 (Image Landsat Copernicus), 2009 (Texas Orthoimagery Program), 1998 (USGS, GLO) and 1989 (USGS)
- LiDAR dataset for Orange County, TX
- NOAA OCM Marsh Migration Viewer provides projected change in land cover types under various SLR scenarios (NOAA/OCM, 2017a)
- Sea Level Rise and Coastal Flooding Impacts (NOAA/OCM, 2017b).
- TxSed Database, a compilation of sediment data collected by Texas General Land Office (GLO) along the Texas Coastal Zone (GLO, 2017).
- NOAA/CO-OPS water-level stations and associated datums (NOAA/CO-OPS, 2017).

Additional data and surveys will be collected during the Design and Implementation phase of the project in support of the preferred plan.

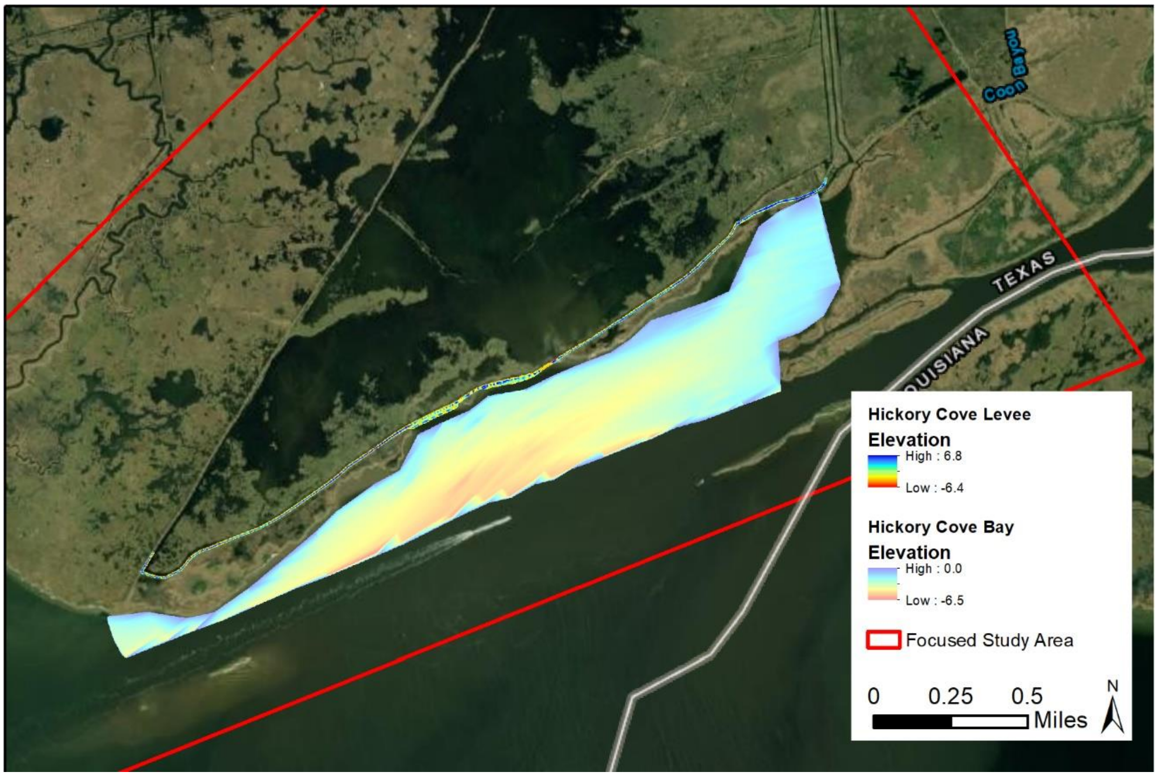

Figure 22. Hickory Cove Bay and containment levee survey (Ducks Unlimited, 2018).

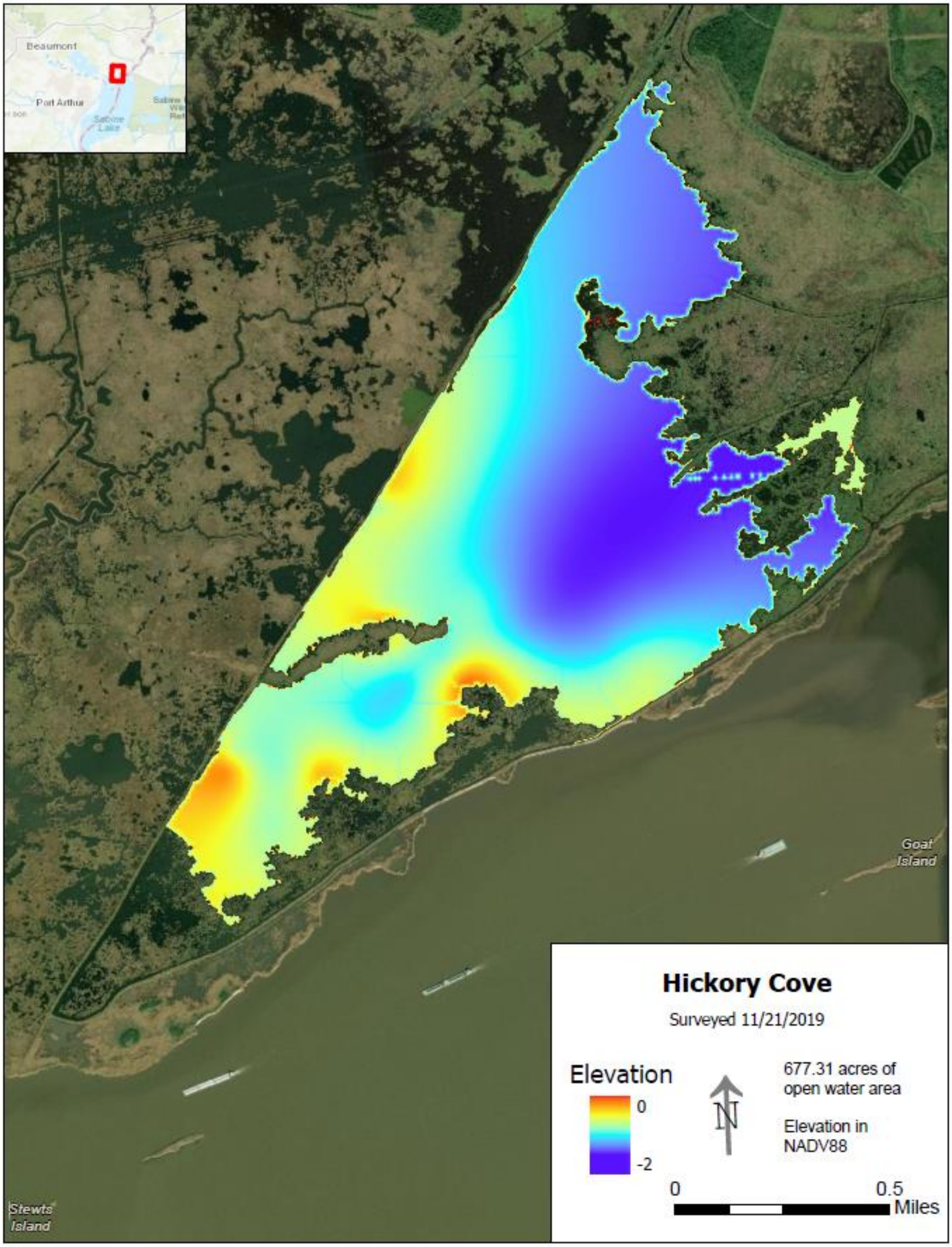

Figure 23. Hickory Cove marsh interior survey

5 GEOTECHNICAL

5.1 Geology

The study area is part of The Beaumont Formation, a spatially expansive late-Pleistocene fine-grained formation, with sediments primarily being fluvial deposits from the Mississippi River and delta system. Beaumont clay is the predominant soil. Fine -grained, poorly graded sand and silt are sometimes found in this formation.

5.2 Geotechnical Analysis and Assumptions

Geotechnical analysis has not been conducted for this study nor have soil borings or testing been done. Adequate existing soils information has not been collected in areas for construction of the breakwater. Soil investigations should be completed during the design and implementation phase to characterize the soil stratums in the area. The TxSed database provides limited information about grain size in and around the study area (fig 24-25, Table 4) (GLO, 2017). This database is maintained by Texas GLO but is obtained from many sources including TPWD, USACE and GLO among others.

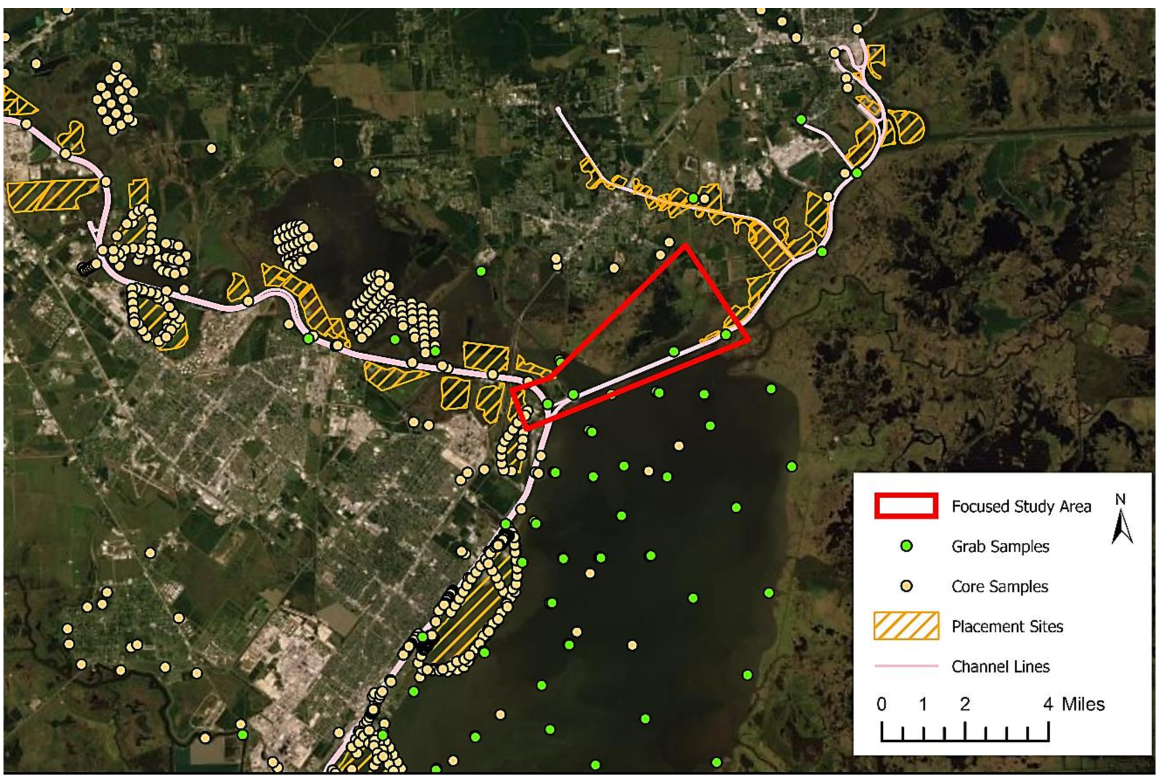

Figure 24. Sediment data available in and around study area (GLO, 2017)

Figure 25. TxSed Samples in or near the study area (GLO, 2017)

Table 4. Sediment Sample Summary of Grab Samples in Figure 25

Sample ID	Sample Date	Sand	Silt	Clay	Gravel	Phi Size	Water Body
TBEG_PSN19	January 19, 1977	45%	29%	18%	8%	5	Port Arthur - Sabine-Neches Canal
TBEG_PSN29	January 19, 1977	12%	64%	24%	0%	7	Port Arthur - Sabine-Neches Canal
TBEG_PSN35	January 19, 1977	79%	15%	5%	1%	3	Port Arthur - Sabine-Neches Canal
TBEG_SLP100	January 19, 1977	67%	25%	8%	0%	4	Sabine Lake
TBEG_SLP101	January 19, 1977	21%	60%	19%	0%	6	Sabine Lake
TBEG_SLP102	January 19, 1977	95%	4%	1%	0%	3	Sabine Lake
TBEG_SLP108	January 19, 1977	21%	68%	11%	0%	5	Sabine Lake

5.3 Feasibility Level Design – Breakwaters

Concept design for offset rock breakwaters (constructed in shallow water away from the banks) are used for estimates. A total maximum base width of 30 feet, height of 6.5 feet, crest width of 4 feet, side slopes of 2H:1V were assumed as shown below for the typical breakwater section (Figure 26). In general, placing of suitable dredged material to raise the existing grade up to the design grade of -3-foot elevation NAVD88. 1-foot thick blanket Stone (1/4 to 4 inches) above the geotextile (Tencate Mirafi 1160 N) base which is considered for the breakwater. Riprap with an average unit weight of 1.6 tons/cubic yard (cy) was considered for the study.

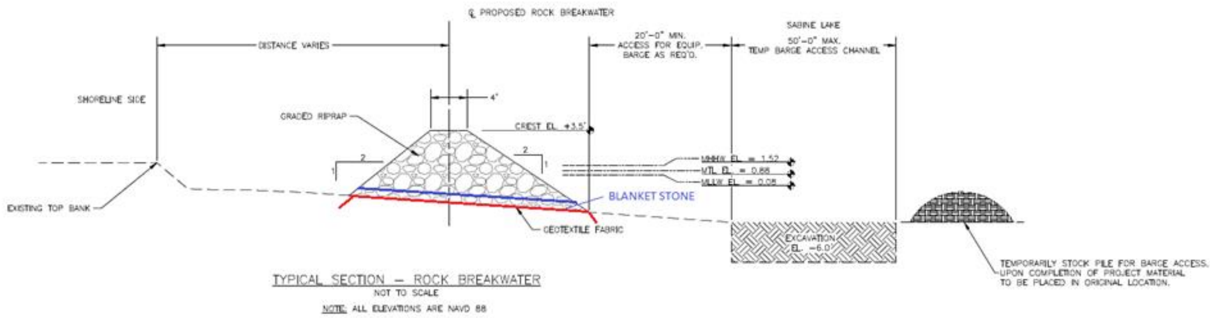

Figure 26. Typical Proposed Breakwater Section

6 FEATURE DESIGN

Discussed herein are the assumptions and design considerations associated with the array of feasibility level alternatives. Measures include marsh restoration, shoreline armoring and shoreline stabilization with a breakwater.

6.1 No Action Plan

The alternative to utilizing dredge material for marsh restoration is placing the material in a nearby placement area. Placement areas 29A and 29B were evaluated for their capacity, or what is required to bring them to capacity, to store additional dredge material. The upland site is located on a small bluff along the left ascending bank at the mouth of the middle pass of the Sabine River delta in Orange Co. Texas. The site contains two placement cells; Cell B in the northerly portion containing 175 acres and Cell A in the southerly portion containing 500 acres. There is an existing engineered outfall structure in each cell. Two exclusive areas are directly adjacent to the existing embankments and should be avoided. The exact nature of the avoidance areas is unknown. These avoidance areas occur in low laying areas along the northerly margin between the banks of Coon Bayou and the Sabine River of containment Cell 29A and an additional area along the northern perimeter in the Southerly portion of containment Cell 29A. The Sabine River navigation channel occurs along the southern border and the centerline of it serves to delineate the political boundary between the states of Texas and Louisiana. The placement areas, shown in Figure 27, will require modification to current capacity to hold additional dredge material. Current conditions and options to increase the capacity are summarized in Table 5. The quantities summarized reflect the minimum need to bring 29A/B to the elevations identified in the first column of the Dike Raise Options. Due to the uncertainty regarding available material at the time of this analysis, two dike raise options were evaluated to provide an understanding of how much of the total required material would be needed towards containment improvements alone to make the placement area, whether Hickory Cove or PA 29A/B, suitable to place additional material. Repairs to the Hickory Cove containment dike would require approximately 28,644 CY of material, a fraction of the needs described in Table 5.

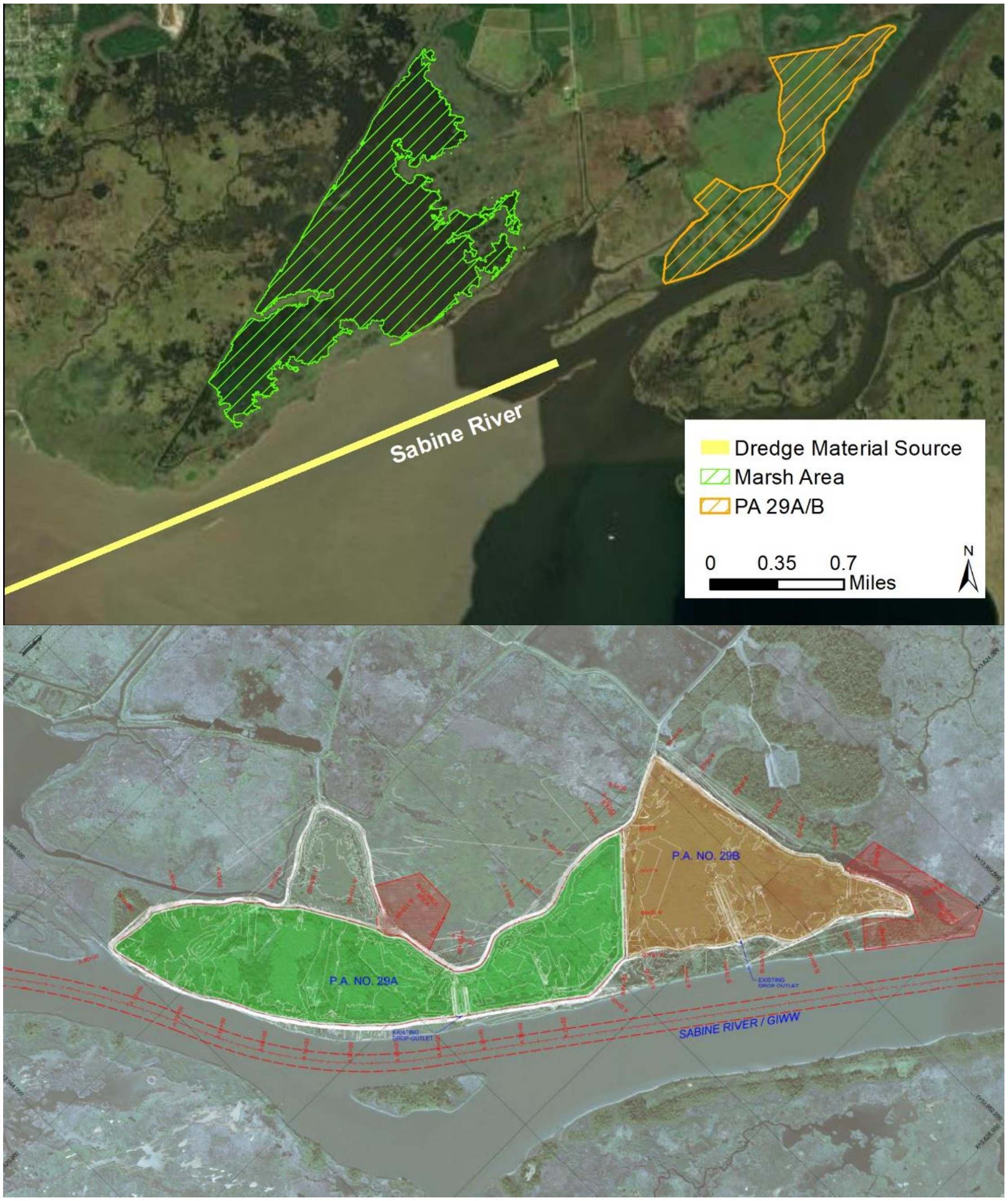

Figure 27. Placement areas 29A/B

Table 5. Geotechnical analysis summary of required PA 29A/B site design improvements

Current Conditions

- Outlet structures at both 29A and 29B need to be replaced to make site operational

	29A	29B	Total	
[1]Current Capacity (cu yds)	233,194	111,113	344,307	

Note 1: Current capacities doesn't maintain a 3 ft Freeboard throughout the PA.

Dike Raise Options

	29A	29B	Total	
[1]Raise to Both Cells to Elev. +13.0 ft (cu yds)	233,194*	522,635	755,828	
[1]Raise Both Cells to Elev. +16.0 ft (cu yds)	816,580	975,065	1.8 million	

Note 1: This elevation includes the required 3 ft Freeboard.
*Note *: This option will only increase Freeboard to 29A. It will not increase the current capacities.*

6.2 Marsh Restoration

The purpose of the Section 1122 pilot program is to demonstrate how dredged material can be beneficially used for the purposes summarized in Section 1.2 of this appendix. Coastal marsh is essential habitat for both terrestrial and aquatic species but also plays a key role in stabilizing shorelines, reducing storm damage to property and infrastructure, and mitigating the impacts of climate change (such as sea level rise) on coastal habitats and communities. Target elevations were established based on successful vegetation establishment at the Old River Cove restoration site in the adjacent Lower Neches Wildlife Management Area adjacent to Hickory Cove, managed by the Texas Parks and Wildlife Department (TPWD).

The assumptions and design considerations associated with marsh nourishment at Hickory Cove include:

- Target elevations aim to fill 60% of the marsh to 1.2 ft. and 40% of the marsh to approximately 0.5 ft. NAVD88 based on resource agency input;
- An existing containment levee will be restored with material from the marsh interior to limit tidal influence and salinity intrusion to the marsh;
- Training berms will be constructed from in-situ material during nourishment;
- Quantity calculations assumed 20% settlement
- The sediment source for marsh creation is assumed to be from the SNWW or the GIWW, either the Neches River or Sabine River segments, depending on dredge cycle timing and available quantities;

- Plantings will be provided by TPWD consistent with the adjacent Old River Cove reference site.

Available marsh nourishment quantities were provided by SWG Operations Branch based on a range of potential expected quantities determined by the dredging depth. The area of marsh to be restored with the corresponding quantity was based on hydrographic survey data and engineering assumptions. The current elevation of the marsh is shown in Figure 23. The containment levee quantities for feasibility are based on Ducks Unlimited preliminary designs as shown in Table 6. The AAHU's associated with each range listed below are described in Appendix B – Ecological Modeling, Section 3. Marsh restoration is assumed to start accruing benefits immediately but at 25% in year 1, 50% in year 2, and 100% in 3 as described in Appendix B.

Table 6. Marsh Restoration and Containment Levee Quantities

	Range Upper Limit (CY)	***500K***	***900K***	***1.3M***	***1.5M***
Sediment Quantities	**Area (acres)**	68	126	190	213
	Marsh Restoration (CY)	468,000	867,000	1,310,000	1,470,000
	Training Berm Length (LF)	5,900	13,360	16,000	16,410
	Training Berm Quantity (CY) H = 5.5 FT	27,940	63,200	75,700	77,640
	Containment Levee Restoration (CY) (earthen, in situ matl source)	28,644	28,644	28,644	28,644
	Total (CY)	**496,644**	**895,644**	**1,338,644**	**1,498,644**
Plantings	**Interior Fringe Plants**	**6,013**	**13,615**	**16,306**	**16,724**

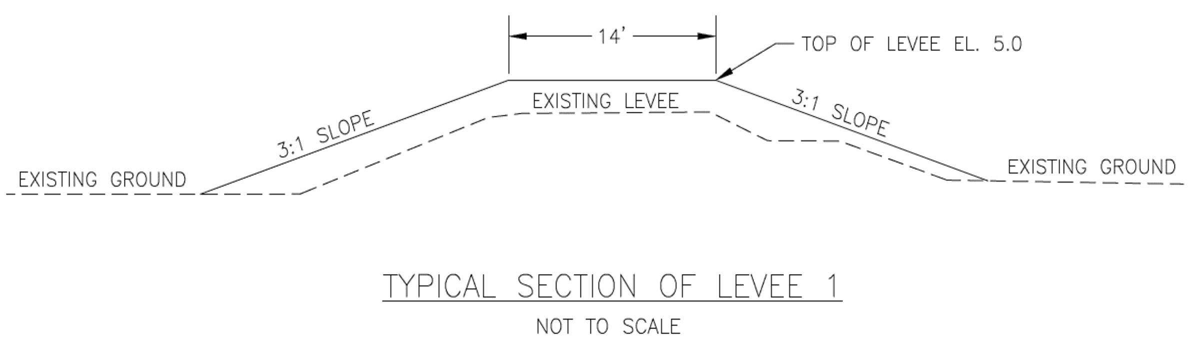

Figure 28. Typical Containment Levee Section for Hickory Cove (Ducks Unlimited, 2018a)

6.3 Breakwater

As previously stated, the purpose of the Section 1122 pilot project to be implemented at Hickory Cove is to demonstrate how dredged material can be beneficially used to restore critical marsh habitat. Marshes along the Gulf Coast are receding due to many factors including interruption of freshwater inflows, erosion due to wind waves, navigation traffic, climate change and increased salinity destabilizing sensitive vegetation that aids in shoreline stabilization. These at-risk marshes will continue to erode and recede without protection especially in areas along navigation channels and large bodies of water as identified in the General Marsh Model discussed previously in Section 3.6 (Ducks Unlimited, 2013). The containment levee is vulnerable to coastal forces and insufficient to prevent marsh degradation over time.

Hickory Cove's shoreline runs parallel to the SNWW/GIWW on the northern side of Sabine Lake and is exposed to wave action that has repeatedly degraded the containment levee on the exterior of the marsh. In addition to navigation traffic subjecting the shoreline to erosive forces, Hickory Cove's shoreline is along the northern boundary of the lake with a significant fetch leaving it vulnerable to wind-driven and ship induced wave action. Attenuating waves was considered necessary to mitigate marsh degradation exacerbated by these conditions. The preliminary design of this feature is shown in Figure 29. The assumptions and design considerations are as follows:

- Breakwater would be placed sufficiently offset from the boundaries of the SNWW navigation channel to allow for safe navigation;
- Breakwater would be placed approximately at the -3 feet contour up to a crest elevation of +3.5 feet;
- Quantities assume 1 ft. initial settlement.
- Openings would be required at access points required for fisheries access or circulation (to be determined in Design and Implementation phase);
- The base of the armoring should be on filter cloth ballasted to secure placement and prevent displacement of outboard edges;
- Armoring in the form of a breakwater placed on the natural bottom outside the dredged SNWW channel reduces ship-wake induced shoreline erosion and would facilitate construction and maintenance;
- A disadvantage to armoring in the vicinity of the channel is the danger that an empty barge tow be blown off course by strong onshore winds, damaging the armoring or empty barges;
- It would not be practical or necessary to construct the armoring to an elevation above water levels associated with tropical events. In the event of hurricane tides, the armoring would be inundated at an early stage in the approaching storm tides and would not suffer severe damage as a result of being completely inundated.

Table 7. Summary of Breakwater Quantities based on Figure 29

	Length (ft.)	*Stone Tonnage*	*Blanket Stone Tonnage*	*Geotextile Area (SY)*
Quantities	14,623	109,142 tons	28,592 tons	64,341

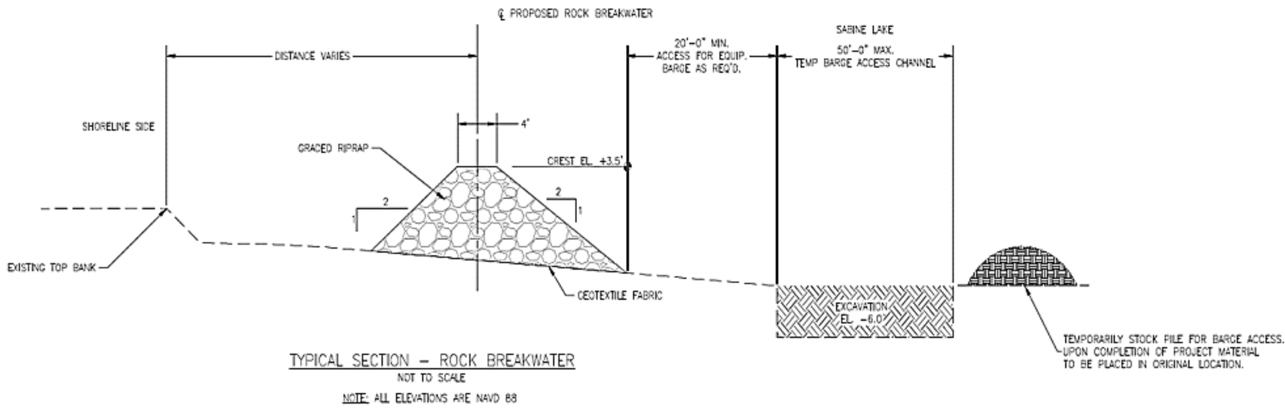

Figure 29. Typical Breakwater Section for Hickory Cove (Ducks Unlimited, 2018b)

6.4 Living Shoreline

The erosive forces along the shoreline of Hickory Cove caused habitat to erode on the exterior of the containment levee, resulting in breaches in some locations. Installing a detached breakwater between the navigation channel and the shoreline will attenuate waves and reduce risk of future breaches in the containment levee. Additional measures can be put in place to further stabilize the shoreline as well as promote sediment accretion to regain lost habitat through the implementation of a living shoreline. Unlike the interior marsh area that will be planted with freshwater marsh vegetation, the exterior of the containment levee should be planted with salinity tolerant vegetation as it will be exposed to the Sabine Lake estuary.

Shoreline stabilization measures are included in Alternative 3 with the aforementioned breakwater and living shoreline on the exterior of the containment levee for added protection and to promote sediment accretion. The number of intended plantings are summarized in Table 8.

Table 8. Summary of Living Shoreline Quantities

Shoreline Area (acres)	*Plant Spacing (inches)*	*Number of Plantings*
95.4	60	217,000

6.5 Sediment Sources

Section 1122 of WRDA requires that the Hickory Cove pilot project beneficially use dredge material to restore critical marsh habitat. The project proposal recommends the Sabine River segment shown in Figure 30 as the ideal sediment source location for this restoration effort. The non-Federal Sponsor for the Sabine River reach is the Orange County Navigation and Port District. The Sabine River is not regularly dredged and there is no current Dredge Material Management Plan in effect. Shoaling has occurred during major storm events and has raised the need for emergency maintenance dredging, the most recent being 2012.

SNWW from the Gulf of Mexico to Port Arthur and Port Beaumont is authorized to 40ft MLLW. The Sabine River reach, the portion of channel from the SNWW proposed to be dredged for the Section 1122 project, is authorized to 31ft MLLW. The non-Federal Sponsor for the 40ft MLLW portion of the SNWW is the Sabine-Neches Navigation District.

Approximately 21,000 linear feet of the Sabine River is proposed to be dredged to a depth of 26 feet MLLW. The 26-ft. dredge depth limitation, despite the authorized channel depth of 31-ft., was due to areas further up the channel being shoaled to a depth of 26-ft. The limitations on being able to utilize the full depth due to shoaling further upstream led to the determination that dredging to the authorized depth was not beneficial to the government. The 26-foot depth dredging would provide approximately 500,000 cubic yards of sediment.

Potential sediment sources near the study area, including but not limited to those in the proposal, were identified and include the sections shown in Figure 30. Available quantities are summarized as follows:

- BUDM associated with maintenance material from the SNWW (Neches River)
  - Approximately 1M cubic yards of sediment is dredged from the lower Neches River on average every 3 years with the next dredging cycle planned for FY 2021.
- BUDM associated with maintenance material from the SNWW (Sabine River)
  - Approximately 1.3M cubic yards of dredge material available from the section of Sabine River parallel to Hickory Cove's shoreline due to shoaling.

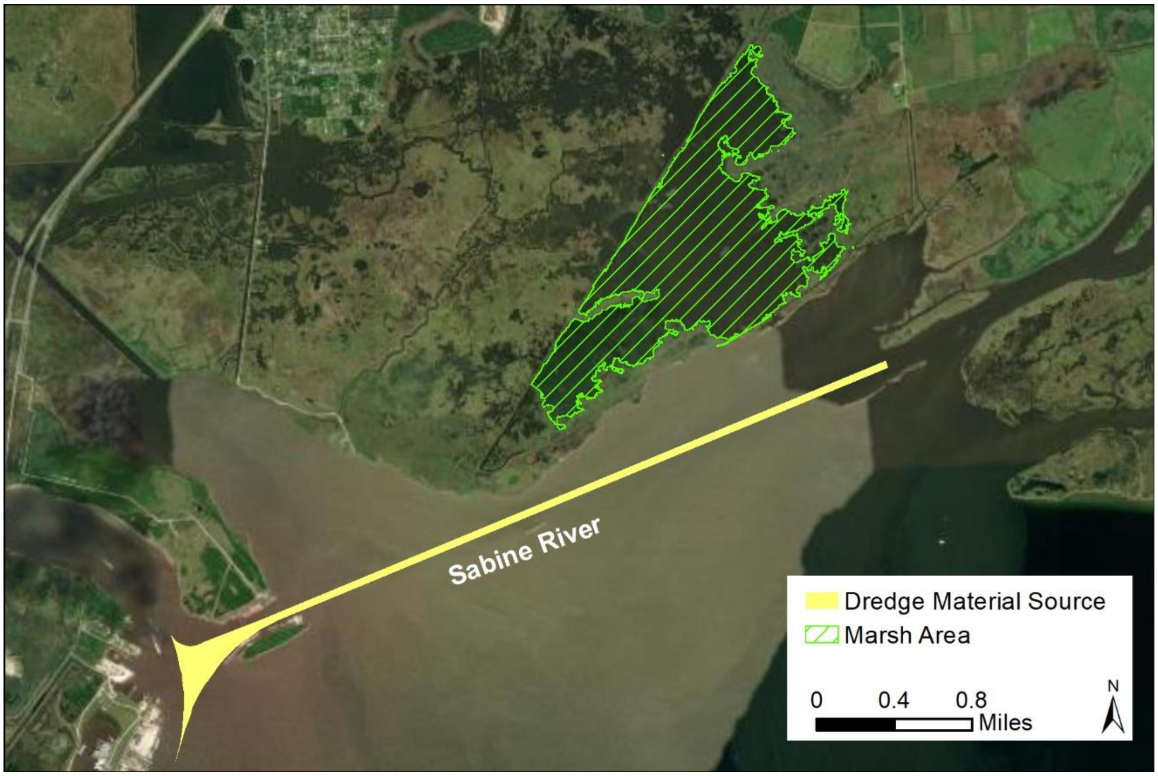

Figure 30. Potential Dredge Material Sources near Hickory Cove

7 RECOMMENDED PLAN AND D&I PATH FORWARD

7.1 Tentatively Selected Plan (TSP)

Following the TSP Milestone, the expected available sediment quantity was assumed to be 1.3 million cubic yards. The recommended plan, Alternative 3, includes containment levee repair, marsh restoration of 190 acres and the construction of a breakwater with a living shoreline. This alternative meets the intent to defend Hickory Cove marsh from erosive forces. The feasibility level designs of the breakwater, containment levee and living shoreline are consistent with the details outlined in Section 6.3 and 6.4.

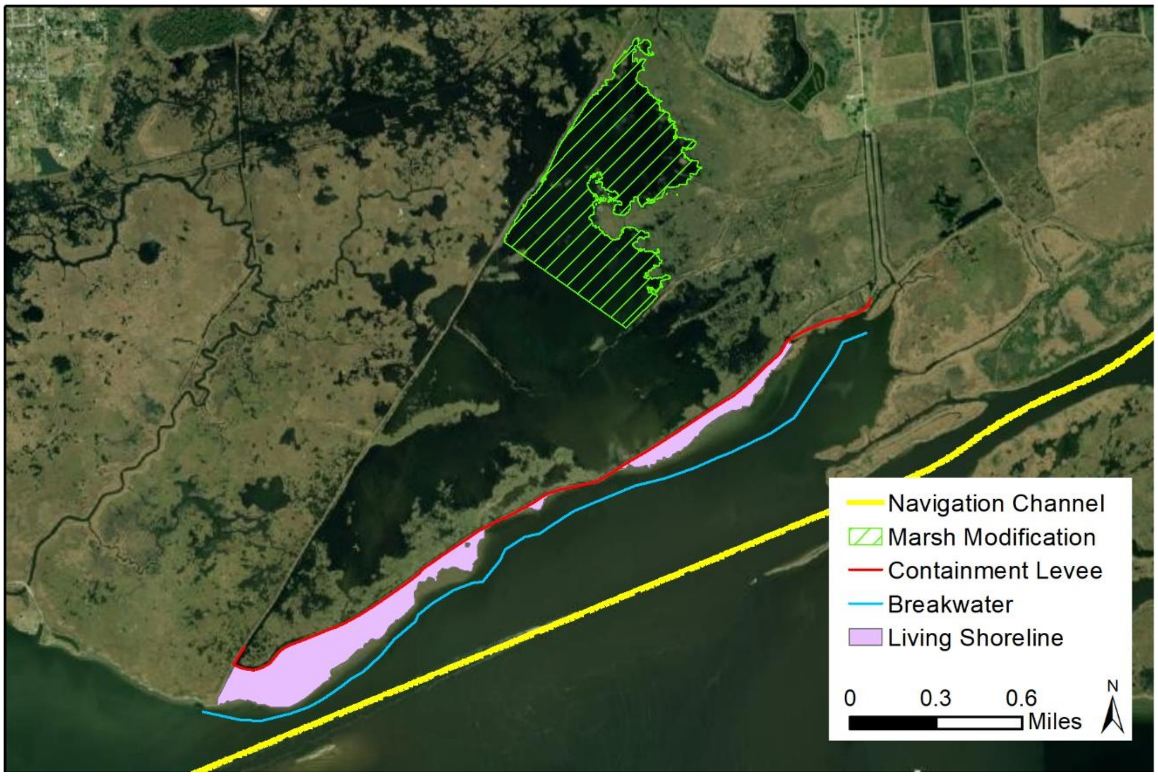

Figure 31. Hickory Cove tentatively selected plan, alternative 3.

7.2 Value Engineering (VE)

Alternative 3, the recommended plan, was further investigated with a value engineering approach. This approach aims to provide the essential function at the lowest possible cost. This alternative may be revisited as an optimized design option during the D&I phase of the project if the shoreline is considered redundant. Opportunities to reduce cost were considered in the shoreline protection component, specifically breakwater length. The containment levee is necessary as is to prevent salinity intrusion, but the breakwater protecting it extends northeast into an area of Hickory Cove Bay already protected by land at the outlet of the Sabine River. This section of land offers some protection from the navigation channel and it was proposed that a section of breakwater parallel to it could be shortened, while the marsh area, containment levee and living shoreline components remain the same. The adjusted breakwater length considered is shown in Figure 32 and updated quantities in Table 9. It was determined that the environmental benefits lost because of a shortened breakwater were too significant in comparison to any cost savings achieved, and the original breakwater length is proposed in the recommended plan.

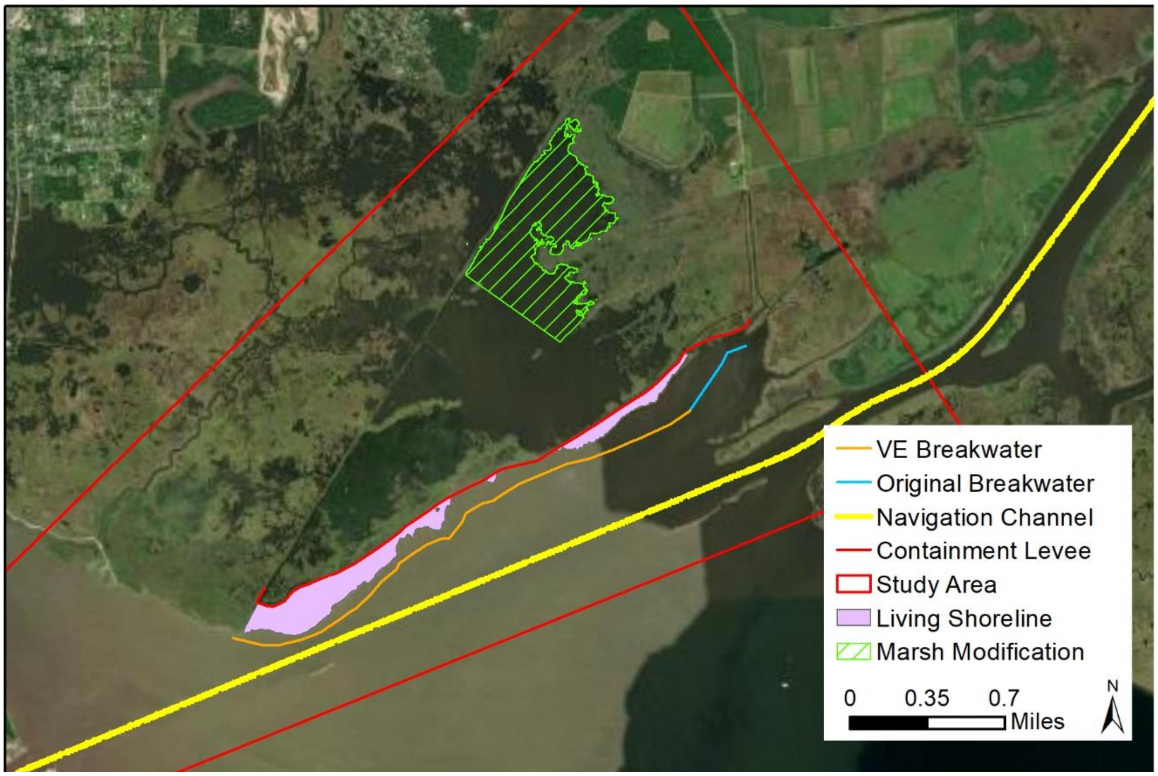

Figure 32. Hickory Cove recommended plan VE alternative

Table 9. Summary of VE Breakwater Quantities

	Length (ft.)	*Stone Tonnage*	*Blanket Stone Tonnage*	*Geotextile Area (SY)*
Quantities	12,576	82,575 tons	22,354 tons	41,920

7.3. Design and Implementation (D&I) Path Forward

There will be additional data and analysis requirements during the Design and Implementation (D&I) phase of the project that will inform project optimization. These include:

- Collection and consideration of Hickory Cove Bay hydrographic survey and containment levee survey data
- Collection of detailed geotechnical data, such as soil borings, to inform final design quantities
- Refinement of marsh cell boundaries based on availability of O&M dredge material and detailed geotechnical analysis if necessary
- Revisiting project alternatives to optimize design considerations for all aspects of the project plan, including marsh restoration strategy

The breakwater design supplied by Ducks Unlimited is typical for marsh habitat along navigation channels and/or tributary channels. While Hickory Cove lies along the Sabine River it's also along the northern boundary of Sabine Lake Estuary. These open water conditions are like that of a bay, for example, where wind waves play a significant role. While the fetch-based analysis performed in 2019, described in Section 3.4.4.2, resulted in a wave height of 3.08-ft NAVD88 for the 10-yr storm, the wind wave analysis performed since as part of the Sabine Pass to Galveston Bay, TX Pre-Construction, Engineering and Design (PED) Hurricane Coastal Storm Surge and Wave Hazard Assessment reports a wave height of 16.6-ft NAVD88 for the 10-yr storm and 26.5-ft for the 100-yr storm, 50% confidence level (Melby et. al., 2021). This updated analysis should be considered in the breakwater design moving forward. Additionally, subsidence of marsh may result in additional material required to meet desired marsh elevation. Starting marsh elevation is possible to have some error involved. Additional data sources may be available for later milestones to validate initial feasibility level assumptions.

Construction costs, described in Appendix D, include initial construction of breakwater, containment dike and marsh restoration. Marsh restoration costs include the construction of training berms and the moving of the dredging pipe to establish appropriate elevation(s) throughout the marsh. Cost of plantings include the living shoreline plants, while interior plantings along the training berms will be donated by TPWD from a neighboring successful restoration site, Old River Cove, with similar elevation targets. Once plantings are placed along the boundaries of the restoration area, it is assumed that they will establish throughout the marsh if target elevations are reached.

9 REFERENCES

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Galveston District

Appendix B-1

Fish and Wildlife Coordination Act

for

WRDA Section 1122 Beneficial Use Pilot Project, Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas

November 2021

The Fish and Wildlife Coordination Act Report (FWCAR) will be placed here when it is received from US Fish and Wildlife Service.

US Army Corps
of Engineers ®
Galveston District

Appendix B-3

Clean Water Act Compliance

for

**WRDA Section 1122 Beneficial Use Pilot Project,
Beneficial Use Placement for Marsh Restoration Using
Navigation Channel Sediments Hickory Cove Marsh,
Bridge City, Texas**

October 2021

Section 404

404(b)1 Short-Form

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

WRDA Section 1122 Beneficial Use Pilot Project, Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas

GUIDELINE COMPLIANCE:

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

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

* Where a 'Significant' category is checked, add explanation below.

List Appropriate References: Chapter 4 of the DIFR-EA.

Little or no movement of dredged or fill material is anticipated to occur following dewatering and consolidation of sediments used for the marsh restoration units. This is due to the typically low velocities of water flow across the marsh areas, construction of temporary containment dikes around the restoration units, and the use of the best available techniques and BMPs during construction.

During dredging and construction activities, localized effects to water quality is expected, including increased turbidity and total suspended sediments, organic enrichment, reduced dissolved oxygen, elevated carbon dioxide levels, and decreased light penetration, among others. Potential adverse effects on biota, including primary production photosynthesis, suspension/filter feeders, and sight feeders, could be primarily associated with increased turbidity and total suspended sediments, water temperature changes, and lower dissolved oxygen during dredging and construction activities. Any such direct adverse effects to water quality and indirect adverse effects to biota would generally be temporary and localized. Following dredging, placement, and construction activities, overall water quality in the localized impact area would return to pre-construction conditions.

Dredging and placement of dredged material would smother and destroy immobile benthic organisms and force mobile benthos to move from the borrow and discharge areas. It is expected that benthic organisms would re-colonize the borrow sites and the dredged material fill/discharge sites within 1-3 years due to its similarity with the existing substrate in the disposal areas . The repair of the existing containment levee breaches would preclude aquatic organisms from re-entering the disposal area; however, establishment of a living shoreline and accretion of marsh anticipated from trapping sediment behind the breakwater would increase suitable habitat for aquatic organisms resulting in no net loss. Temporary containment/exclusion dikes would naturally degrade or would be breached in multiple places following construction, if necessary, to restore aquatic organism and fish access from other marsh areas if natural degradation is not sufficient. Following construction, dredged sediments would consolidate and differentially settle to different elevations thereby resulting in development of lower-lying areas that would develop into small ponds and streams further enabling aquatic organism access from surrounding waters. Coastal marshes in the project area have been fragmenting, degrading, and converting to less productive marshes or open water at a significant rate. Therefore, restoring marsh is considered to have a higher ecological value than open-water because of its benefits to terrestrial and aquatic organisms in an areas with decreasing wetland habitats.

Stone placed for the breakwater structures is expected to settle initially following construction due to the overburden pressure that the stone would create on underlying unconsolidated substrate. However, placement of geotextile fabric between the stone and substrate would help to prevent the complete sinking of the rock over time. Placement of stone would have localized effects to water quality, including increased turbidity and total suspended sediments. These impacts would be expected to cease following placement.

During construction of the breakwaters, the placement of geotextile fabric and stone would smother sessile and slow-moving benthic organisms and force mobile organisms to move from the placement site. The rock and geotextile fabric, by design, covers benthic subtidal sediments; hence infauna would likely be absent. However, stone would provide substrate for epifaunal colonization . Opening in the structure would allow for continued movement of aquatic species between Sabine Lake and the shoreline.

Construction of the living shoreline would not involve placing dredged material or filling in Waters of the US.

3. Evaluation of Dredged or Fill Material (Subpart G)		
a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material (check only those appropriate)		
1) Physical characteristics	X	
2) Hydrography in relation to known or anticipated sources of contaminants	X	
3) Results from previous testing of the material or similar material in the vicinity of the project	X	
4) Known, significant sources of persistent pesticides from land runoff or percolation	X	
5) Spill records for petroleum products or designated (Section 311 of Clean Water Act) hazardous substances	X	
6) Other public records of significant introduction of contaminants from industries, municipalities or other sources	X	
7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities	X	
3. Evaluation of Dredged or Fill Material (Subpart G) (continued)	**Yes**	**No**
b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredged or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and placement sites and not likely to degrade the placement sites, or the material meets the testing exclusion criteria.	X	

Sediment dredged from the SNWW would be beneficially used to complete marsh restoration and existing containment levee repairs. The dredged material has been characterized as silt and clay, with varying amounts of organic material and sands.

USACE has collected and archived a significant amount of water and sediment chemistry data as well as elutriate data that provide information on the constituents that are dissolved into the water column contained during dredging and placement. Historical water and elutriate data for detected compounds from 1987, 1990, 1992, and 1998[1]. Lead and zinc were the only metals found above detection limits in 1987 at all stations in water and elutriate samples. One water sample from station S-SP-87-06 contained 98.0 µg/L of zinc that slightly exceeds the state water quality standards (92.7 µg/L). However, the elutriate value was low indicating no release of zinc to the water column during dredging or placement. Metals were not detected in 1990, and in 1992 the only metal found above detection limits was cadmium (in water) at station S-SP-92-06. In 1998, barium and zinc concentrations were found above detection limits for water and elutriate and were consistently higher in the elutriate samples. This contrasts to the 1987 samples, in which elutriate values were normally lower than water concentrations. Arsenic was detected at most stations in water and two stations for elutriate; cadmium and nickel were found in water only. All values, except the zinc value noted above, were below the water quality criteria (WQC) and state water quality standards.

Oil and grease were detected in 1987 in water and elutriate samples. Ammonia, which was not measured until 1996 was found above detection limits in all elutriate samples for 1998. For the organics,

[1] PBS&J. 2004. Sabine-Neches Waterway Entrance Channel 2004 Contaminant Assessment. Document No. 040338. PBS&J. Austin, Texas.

in 1987 fluoranthene was above detection limits at one station. TOC was detected in all water and elutriate samples during 1992, and elutriate concentrations were consistently higher than water concentrations. Based on available water and elutriate data, there is no indication of current water or elutriate contaminant problems along the SNWW.

For the breakwaters, stone and geotextile fabric would be used to construct the structure. The stone would come from an upland quarry and would be transported to the fill site by barge. Cranes and other heavy equipment would be used to place the stone to construct the breakwaters. The stone would be free of any chemicals or sealants that could be harmful to the environment.

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

4. Placement Site Delineation (230.11(f)) (continued)	**Yes**	**No**
b. An evaluation of the appropriate factors in 4a above indicates that the placement site and/or size of mixing zone are acceptable.	X	

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

List actions taken:

1) Best available practical techniques and BMPs would be utilized during dredging and construction activities to avoid and minimize potential temporary and long-term adverse impacts, such as maintaining a work area that remains aesthetically attractive free of floating or piled debris and trash, storing fuels and other hazardous materials in locations which would not be introduced to surface waters if spilled, using silt curtains when appropriate to minimize movement of sediments, etc.

2) Movement of heavy equipment and support vehicles would utilize placement pipeline corridors to the greatest extent possible. Staging areas, access corridors, and general ground disturbance not related to restoration would utilize the smallest footprint possible to maintain a safe work environment.

3) Geotextile/filter cloth would be placed under the breakwater structure to reduce subsidence of placed rock over time.

4) Movement of sediment during and post-construction would be contained by constructing temporary earthen containment/exclusion dikes around the marsh restoration sites. Dikes would be constructed of in-situ materials and would be breached through natural degradation or mechanical means following sufficient dewatering and settlement of the placed material. The dike would be able to maintain one-foot of freeboard at all times.

5) Only clean fill material (dredged material or stone) free of contaminants would be placed in the restoration area. Placed dredged material will be of such composition that it will not adversely affect the biological, chemical or physical properties of the receiving waters.

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

7. Evaluation Responsibility
a. This evaluation was prepared by: **Melinda Fisher** Position: **Coastal Biologist,** Regional Planning and Environmental Center

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

______________________ Date	____ Amanda M. McGuire Chief, Environmental Branch

NOTES:

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

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

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

SUPPORTING DOCUMENTATION

Project Description

The U.S. Army Corps of Engineers, Galveston District (USACE), in partnership with Ducks Unlimited and the Port of Orange, is exploring the feasibility of implementing a pilot project for the beneficial use of dredged material generated during operations and maintenance dredging of the Sabine Neches Waterway (SNWW) as a means to restore degraded marsh lands. This project is one of ten final proposals evaluated and selected from 95 submittals because it has a high environmental, economic, and social benefits, and exhibited geographic diversity.

The project is located within Hickory Cove Bay in an area known as the saddle where the Sabine and Neches rivers merge into Sabine Lake in Orange County, Texas. The project area includes 1,200 acres of impounded marsh lands and open water areas of Sabine Lake. The land is owned and operated by the Hawk Club, a private hunting club, and adjacent to the Lower Neches Wildlife Management Area (WMA) which is owned and operated by Texas Parks and Wildlife Department (TPWD). The Sabine Neches Waterway (SNWW) is the only federal navigation project immediately near the study area (Figure 1).

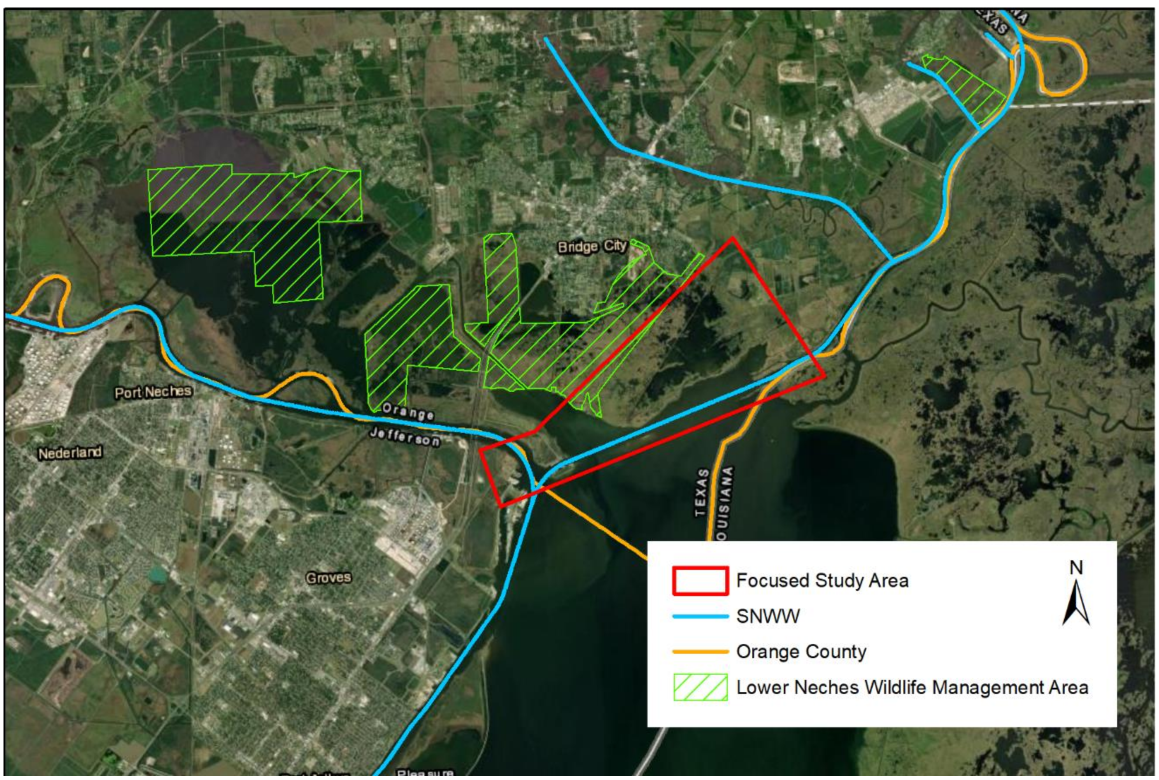

Figure 1. Study Area

Alternative 3 was chosen as the tentatively selected plan (TSP) (Figure 2). This plan involves beneficially using dredged material to restore up to 670 acres of marsh habitat and create resiliency against future conditions. Marsh measures consist of three phases of marsh restoration that would increase land coverage in the project area and improve terrestrial wildlife habitat, hydrology, and water quality. To protect marsh restoration efforts, the project involves repairing an existing containment that will limit hydrologic connection between Sabine Lake and the interior marsh areas to only extreme conditions and create conditions conducive for reestablishment and sustainment of marsh under future conditions. Shoreline measures include construction of rock breakwaters and living shoreline features that help to mitigate erosion, dissipate wave energies, stabilize shorelines, reduce land loss, reduce saltwater intrusion, and support reestablishment of emergent marsh through retention of sediments. Material placed into the marsh and on the existing containment levee would have similar properties to the existing native material. Under the existing and projected future dredging cycles, there is sufficient quantities of suitable material available to meet all restoration needs without seeking other borrow sources (e.g. off-shore, upland placement areas).

Alternative 3 measures have been developed to a feasibility level of design (i.e. estimates, design level that is not detailed enough for construction) based on currently available data and information developed during plan formulation. There is significant institutional knowledge regarding the construction of the restoration measures; therefore, there is minimal uncertainty from a construction standpoint. Uncertainties relating to measure design and performance are mainly centered on site specific, design-level details (e.g. exact sediment quantities, invasive species removal needs, extent of erosion control needs, construction staging area locations, pipeline pathways, timing and duration of construction, etc.), which would be addressed during the pre-engineering and design phase (PED). Additional plan details are provided in the Draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) and the Engineering Appendix of the DIFR-EA (Appendix A).

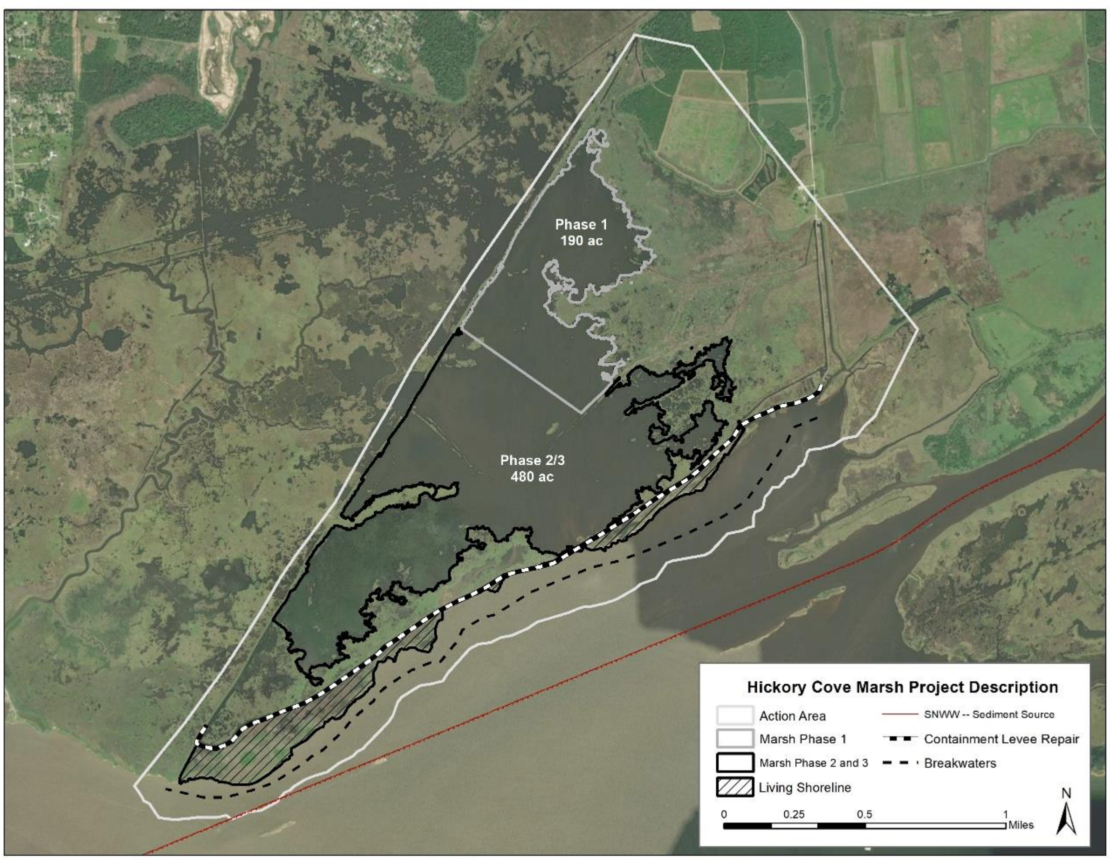

Figure 2. Project Description

Marsh Restoration

Implementation of this project would involve placing approximately 3.5 million cubic yards of material dredged from the SNWW to restore approximately 670 acres emergent marsh dominated by *Spartina patens*. Placement of material would occur over three phases as funding and sediment material becomes available. Phase 1 would involve placing approximately 1.3 million cubic yards of material in the unit, while the Phase 2 and Phase 3 units would need an estimated 2.2 million cubic yards of material.

Dredged material would be hydraulically pumped into open water and low lying areas assuming that 60% of the restoration unit will have a post-construction settlement target elevation of +1.2 feet mean sea level (MSL) and the remaining 40% of the unit will have a target elevation of +0.5 feet MSL. Target elevations were determined based on successful vegetation establishment at the Old River Cove restoration site on the Lower Neches WMA, which was used as an ecosystem restoration reference site, and resource agency input. As necessary, temporary training berms (containment dikes) would be constructed from in-situ material around the nourished areas to efficiently achieve the desired initial construction elevation. The berms would be breached following construction to allow dewatering and settlement to the final target marsh elevation. Vegetation plantings would follow protocols and species assemblages used at the reference site.

Following marsh restoration actions, non-native/undesirable species monitoring would be implemented. If species are found, measures would be taken to stop or slow the expansion of the species within the restoration units.

Containment Levee Repair

The existing containment levee would be repaired to a uniform elevation of +5.0 feet MSL and slopes restored to 3:1 (Figure 3) to limit tidal influence and salinity intrusion into interior existing and restored marshes. Sediment for the repair would come from material placed in the marsh restoration areas.

Under the existing condition, numerous breaches in the levee allow saltwater intrusion and high energy flows which scour and cause erosion, increase land loss, and convert marsh habitat to open water.

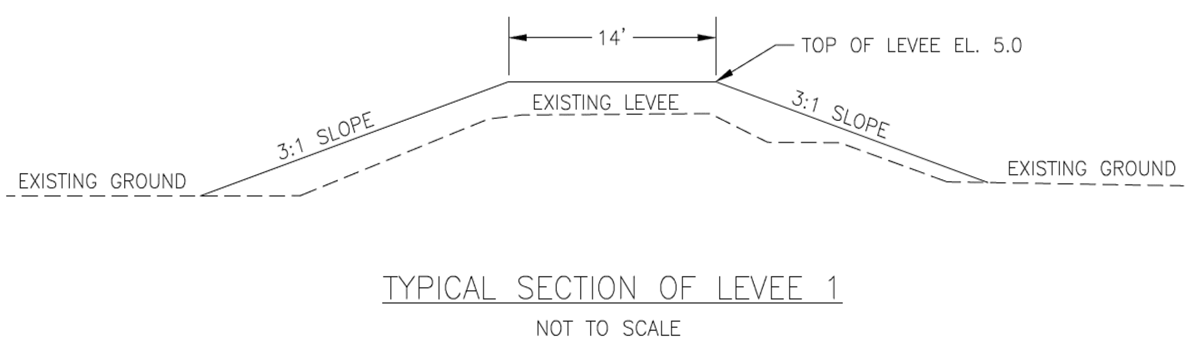

Figure 3. Typical cross-section of the repaired containment levee

Breakwaters

Hickory Cove's shoreline runs parallel to the SNWW/GIWW on the northern side of Sabine Lake and is exposed to wave action that has repeatedly degraded the containment levee on the exterior of the marsh. In addition to navigation traffic subjecting the shoreline to erosive forces, Hickory Cove's shoreline is along the northern boundary of the lake with a significant fetch leaving it vulnerable to wind-driven and ship induced wave action. Attenuating waves through construction of approximately 14,623 linear feet (LF) (~2.8 miles) of breakwaters was considered necessary to mitigate degradation and breach of the containment levee and subsequent marsh degradation exacerbated by these conditions. The preliminary design of this feature is shown in Figure 4.

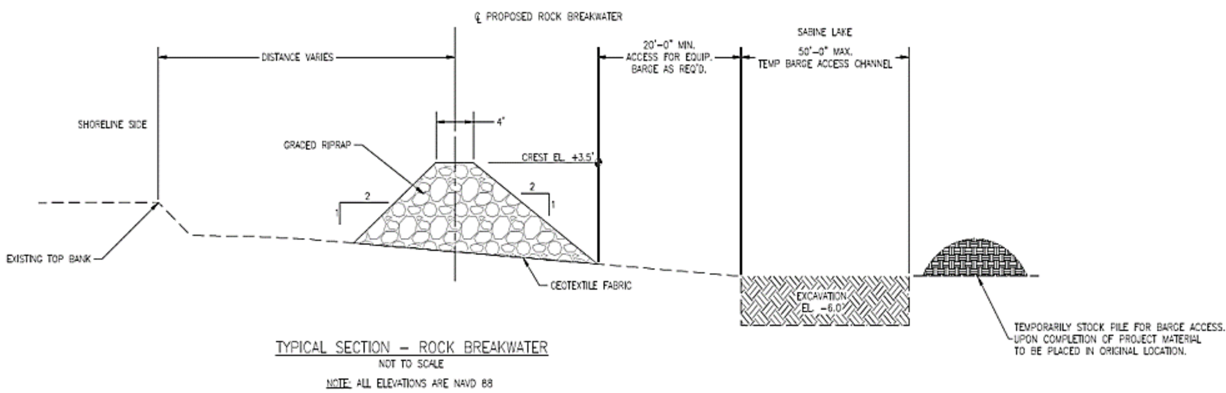

Figure 4. Typical cross-section of the breakwaters

The structures would be built in shallow water (<3 feet deep) at varying distances from the shoreline and where soils are conducive to supporting the weight of the stone without significant subsidence. The distance from the shoreline would be determined during PED, after site specific surveys have been completed, but sufficiently offset from the boundaries of the SNWW navigation channel to ensure continued safe navigation.

The design would be a trapezoidal structure built of approximately 138,000 tons of stone up to a height of +3.5 feet MSL, which will yield approximately 1-1.5 feet of rock exposed above the mean high tide level. Other approximate features of the design include a 4-foot wide crown, a 2:1 slope, and a base that is roughly 30 feet wide. The structure would have a total footprint of approximately 2 acres. The base of the structure would be on filter cloth ballasted to the water bottom to secure placement and prevent displacement of the outboard edges. The number of openings and width of each would be determined during PED and dependent on the location of major channel entrances or access points required for fishery access or circulation and potential for erosion to affect the existing containment levee.

Living Shoreline

A 95-acre living shoreline would be planted between the existing containment levee and the breakwaters. Invasive plant species, primarily Chinese tallow (*Triadica sebifera*) would be removed from the levee and smooth cordgrass (*Spartina alterniflora*) would be planted along the tow of the levee to form the living shoreline. Approximately 217,000 *S. alterniflora* plugs would be planted with 60-inch spacing. Establishment of this feature would provide toe protection to the existing containment levee and promote sediment accretion to regain lost habitat.

Equipment Needs and Access Routes

Sediment transport equipment would most likely include cutterhead dredges, pipelines (submerged, floating, and land) and one booster pump. Heavy machinery would be used to move sediment and facilitate construction. Heavy equipment could include bulldozers, front-end loaders, track-hoes, marshbuggies, track-hoes, and backhoes. For breakwater construction, stone would be purchased from a commercial quarry and transported to the site by barge, where it would then be placed by crane or hopper barge. Various support equipment would also be used, such as crew and work boats, trucks, trailers, construction trailers, all-terrain vehicles, and floating docks and temporary access channels to facilitate loading and unloading of personnel and equipment.

Identification of staging areas, pipeline routes, and placement of floatation docks would occur during PED. Each disturbance for access and staging would be placed outside of environmentally sensitive areas to the greatest extent practicable and utilize areas already disturbed when possible (e.g. stage on existing agricultural bare ground, existing roadways, or mowed/pastured private lands). All ground disturbance for access and staging areas would be temporary and fully restored to result in no permanent loss.

Timing

Timing of initial construction of this project (Phase 1) is dependent on several factors including: timing of authorization, duration of the PED phase, and Federal- and non-federal funding cycles. It was assumed that construction would begin in March 2024 and have approximately 30 months of on-the-ground work (Table 1). These dates and are based on the next projected SNWW Neches River or Sabine River dredging cycle. The timing of Phase 2 and Phase 3 marsh restoration units are uncertain at this time but would not likely occur before 2027 unless an emergency dredging cycle occurs as a result of excess shoaling from a storm event.

Table 1. Anticipated construction schedule

Measure	**Duration**	**Start**	**End**
Dredging, Phase 1 Marsh Restoration, Containment Levee Repair	12	Mar 2024	Feb 2025
Breakwaters	16	Mar 2025	Jul 2026
Living Shoreline	2	Mar 2027	Apr 2027

Description of the Discharge Site(s)

Up to 3 restoration units would receive dredged material and would result in filling in of open water sites or extremely fragmented and deep marsh sites. The breakwaters would be located parallel to the Hickory Cove shoreline in shallow (<3 feet deep) open water. Salinity within the placement areas is variable due to tidal fluctuation.

The project area is along the most northern boundary of the Sabine-Neches Estuary, where the Sabine and Neches rivers enter the Sabine Lake. The estuary exhibits very complicated circulation and salinity patterns. Tidal flow originating from the Gulf, the strength and intensity of winds, intensity of rainfall and associated river inflows, and depth of the SNWW and lake strongly influence salinity in Sabine Lake and in particular the project area.

Approximately 80 percent of the project area is considered inland open water habitat. As described in the DIFR-EA, salinity in Sabine Lake in the project area seaward of the containment levee (breakwater location) is highly dependent on the flows of the Sabine and Neches rivers and the location of the saltwater wedge and can range from 0.0 to over 30.0 ppt with salinity more typically between 4.0 and 18.0 ppt. Here the depth of habitat is shallow (<4.0 feet) and typically very turbid due to the two rivers merging in the project area. This area support little to no rooted vascular plants (submerged aquatic vegetation [SAV]). Phytoplankton are the most likely plant or animal species to occur in this habitat.

Salinity within the open water areas in the interior of the containment levee (marsh restoration) has much higher salinity (well over 18 ppt) because with every tidal surge that breaches the containment levee the higher salinity water gets trapped behind the containment levee and there are not sufficient freshwater flows to reduce salinities. SAV, while very limited, is found along existing marsh edges.

Marshhay cordgrass (Spartina patens) dominates salt marshes where marsh habitat is not being broken up by open water within and external to the containment levee. While fresh and intermediate-brackish marsh are found in the action area in the interior of the containment levee, placement of material would not occur in these habitat types.

Project area sites are used by a variety of marine, freshwater, and terrestrial fauna for resting, nesting, spawning, foraging, etc.; however, diversity and abundance is relatively low because of degraded conditions. For a complete description of species commonly found in the project area see the DIFR-EA.

Section 401

Water Quality Certification

From: Fisher, Melinda CIV USARMY CESWF (USA)
To: "401CERTS@tceq.texas.gov"
Subject: Hickory Cove Marsh BU Pre-Filing Meeting Request
Date: Tuesday, October 12, 2021 2:43:00 PM
Attachments: USACE_HCM_PRE-FILING MEETING REQUEST_12Oct21.pdf

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Good Afternoon,

Please find attached the Pre-Filing Request for a USACE Civil Work beneficial use marsh restoration project in Orange County, TX.

Please let me know if you have any questions or need anything further.

Thanks!
Melinda

~~~~~~

Melinda Fisher
Wildlife Biologist
Regional Planning & Environmental Center (RPEC)
Environmental Branch
Compliance Section
Office: 918-669-7423
Cell: 918-953-9534

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Texas Commission on Environmental Quality
401 State Certification Pre-filing Meeting Request Form

Why is this Pre-Filing Meeting Request Required? The U.S. Environmental Protection Agency published its Clean Water Act Section 401 Certification Rule in the Federal Register on July 13, 2020. It took effect on September 11, 2020. The federal rule requires all project applicants to submit a Pre-filing Meeting Request to the state certifying authority, the Texas Commission on Environmental Quality (TCEQ), at least 30 days prior to submitting a Section 401 Water Quality Certification Request (Certification Request). The TCEQ has prepared this Pre-filing Meeting Request form to help project applicants comply with the new 401 Certification Rule requirements.

Next Steps: The TCEQ will review your request for a Pre-filing Meeting to determine whether it is necessary or appropriate for your specific project, though actually conducting a Pre-filing Meeting is optional. Completing this form will help with the TCEQ's determination. Thank you for using this form.

1. Please submit this request form and a project location map to 401Certs@tceq.texas.gov.

2. If a Pre-filing Meeting is determined to be necessary by either the applicant or the TCEQ, the meeting will be scheduled to discuss the project.

3. If you do not receive a response to your request for a pre-filing meeting, after at least 30 days, you may submit the certification request to the TCEQ if a Section 401 certification is required for your project. Projects that require state certification are 1) all individual permit U.S. Army Corps of Engineer 404 permit applications and, 2) individual conditional certifications for the return water of Nationwide Permit 16.

For more information: EPA's 401 rule: https://www.epa.gov/cwa-401/final-rule-clean-water-act-section-401-certification-rule

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Project Information

Project Name: WRDA 2016 Section 1122 Hickory Cove Marsh, Bridge City, TX Beneficial Use Pilot Project
Project Applicant
Name: Melinda Fisher
Organization: US Army Corps of Engineers, Galveston District
Phone no.: 918-953-9534
Email: melinda.fisher@usace.army.mil
Consultant
Name: --
Organization: --
Phone no.: --
Email: --
Project Location *(Note: Please attach a project location map when submitting this form)*
Address: Hickory Cove at the confluence of the Neches and Sabine rivers
City: nearest city Bridge City

Texas Commission on Environmental Quality
401 State Certification Pre-filing Meeting Request Form

County: Orange

Latitude/Longitude of project location: 29°48’32.25” N 93°48’33.25”W

Brief Project Description and Scope:

The project (Alternative 3) involves beneficially using 3.5 million cubic yards of dredged material from the Sabine-Neches Waterway to restore up to 670 acres of marsh habitat and create resiliency against future conditions. Dredged material would be hydraulically pumped into open water and low lying areas assuming that 60% of the restoration unit will have a post-construction settlement target elevation of +1.2 feet mean sea level (MSL) and the remaining 40% of the unit will have a target elevation of +0.5 feet MSL. Target elevations were determined based on resource agency input and successful vegetation establishment at the Old River Cove restoration site on the Lower Neches WMA, which was used as an ecosystem restoration reference site. As necessary, temporary training berms (containment dikes) would be constructed from in-situ material around the nourished areas to efficiently achieve the desired initial construction elevation. The berms would be breached following construction to allow dewatering and settlement to the final target marsh elevation. Vegetation plantings would follow protocols and species assemblages used at the reference site.

To protect marsh restoration efforts, the project involves repairing an existing containment to a uniform elevation of +5.0 feet MSL and restoring the side slopes to a 3:1 to limit tidal influence and salinity intrusion into interior existing and restored marshes. Sediment would come from material placed in the marsh restorations area. Additionally, two shoreline measures would be completed and include construction of 14,623 linear feet (~2.8 miles) of rock breakwaters and a 95-acre living shoreline that will help to mitigate erosion, dissipate wave energies, stabilize shorelines, reduce land loss, reduce saltwater intrusion, and support reestablishment of emergent marsh through retention of sediments. The breakwater would be trapezoidal in shape and be placed in shallow water (<3’) following the contour, which will yield approximately 1-1.5 feet of rock exposed. The structure would have a total footprint of about 2 acres. The living shoreline would be between the existing containment levee and the breakwaters on existing land and involves removing invasive species and planting approximately 217,000 Spartina alterniflora plugs.

Material placed into the marsh and on the existing containment levee would have similar properties to the existing native material. Under the existing and projected future dredging cycles, there is sufficient quantities of suitable material available to meet all restoration needs without seeking other borrow sources (e.g. off-shore, upland placement areas).

Please provide the type of federal permit for which the applicant is seeking state 401 certification. Please include a federal permit number if available.

No Federal Permit, this is a Civil Works Feasibility Study. A NWP 27 would be applicable but USACE Civil Work policy does not allow water quality certification by proxy for Civil Works projects.

Jurisdictional Impacts

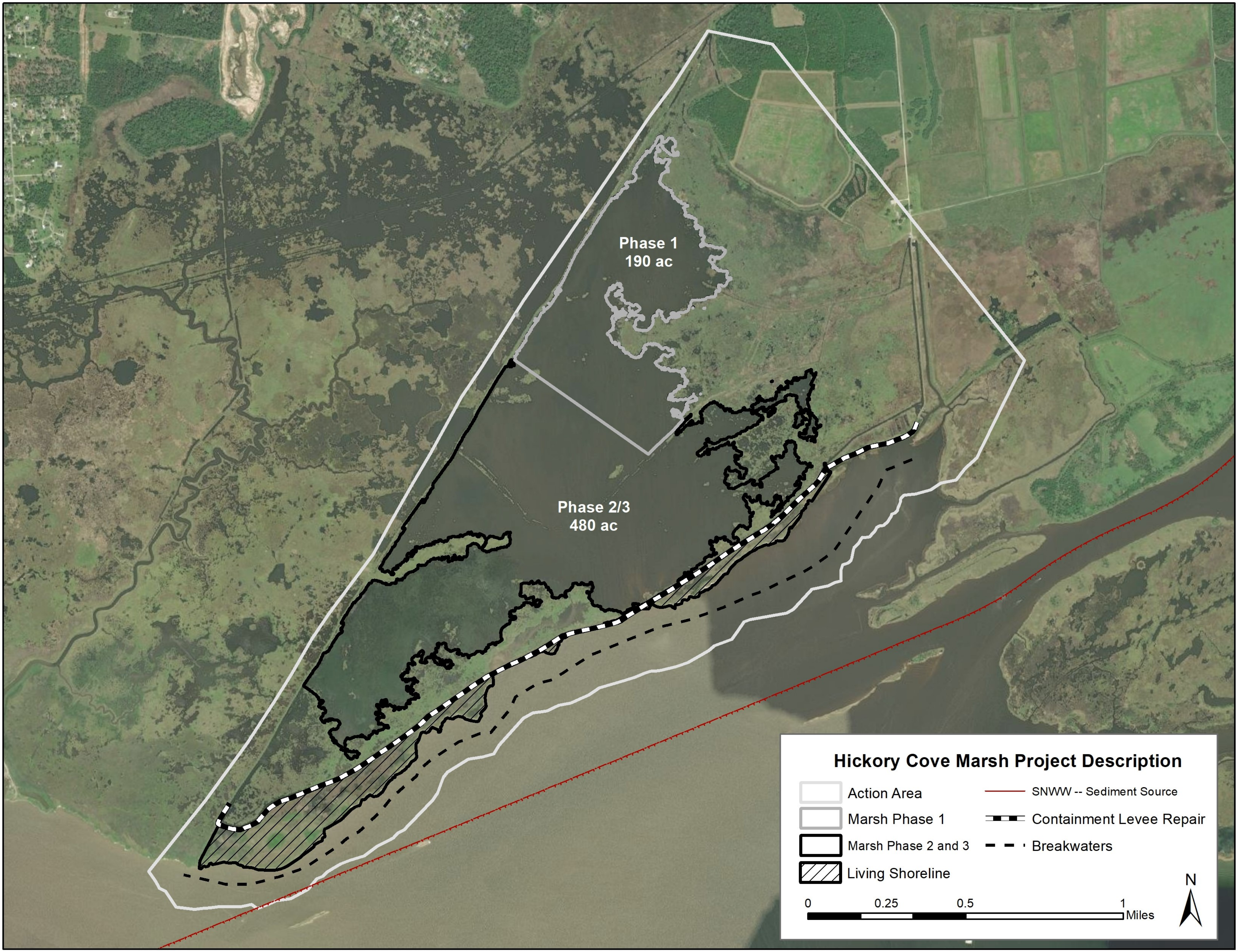
Fill/Excavate	Wetland (Cowardian Class), Seagrass, Oyster	Acres	Stream (linear feet)		
			intermittent	*perennial*	*tidal*

	Example. Fill	Example. Palustrine Emergent Wetland (PEM)	Example. 3				
	Example. Fill			Example. 300	Example. 100		
	Fill	Open Water based on site surveys (NWI maps it as Estuarine and Marine Deepwater [E1UBL] and Estuarine and Marine Wetland [E2EM1P])	670				
	Fill	Submerged lands	2				

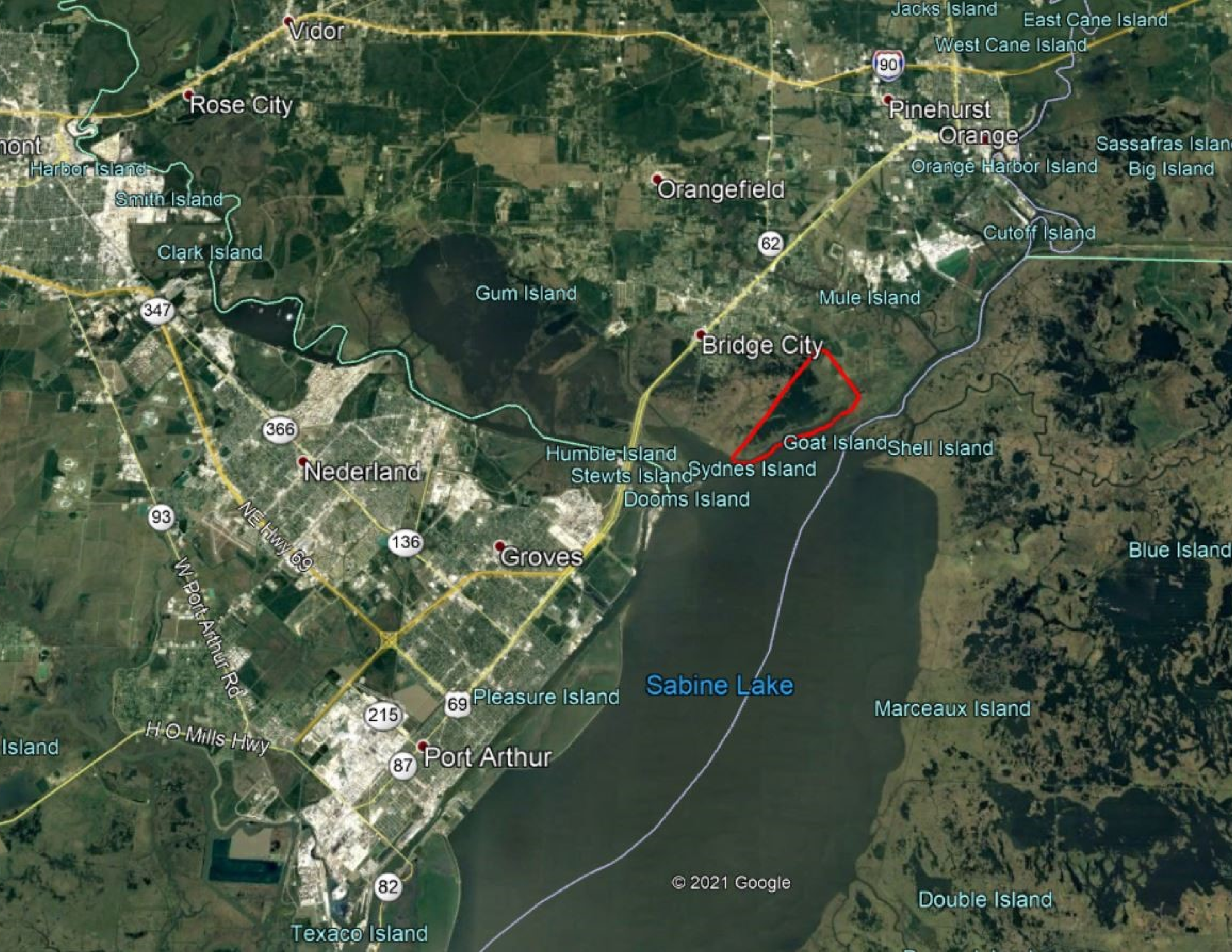
Best Management Practices (BMPs) to be implemented:

1. Best available practical techniques and BMPs would be utilized during dredging and construction activities to avoid and minimize potential temporary and long-term adverse impacts, such as maintaining a work area that remains aesthetically attractive free of floating or piled debris and trash, storing fuels and other hazardous materials in locations which would not be introduced to surface waters if spilled, using silt curtains when appropriate to minimize movement of sediments, etc.
2. Movement of heavy equipment and support vehicles would utilize placement pipeline corridors to the greatest extent possible. Staging areas, access corridors, and general ground disturbance not related to restoration would utilize the smallest footprint possible to maintain a safe work environment.
3. Geotextile/filter cloth would be placed under the breakwater structure to reduce subsidence of placed rock over time.
4. Movement of sediment during and post-construction would be contained by constructing temporary earthen containment/exclusion dikes around the marsh restoration sites. Dikes would be constructed of in-situ materials and would be breached through natural degradation or mechanical means following sufficient dewatering and settlement of the placed material. The dike would be able to maintain one-foot of freeboard at all times.

5. Only clean fill material (dredged material or stone) free of contaminants would be placed in the restoration area. Placed dredged material will be of such composition that it will not adversely affect the biological, chemical or physical properties of the receiving waters.



Phase 1
190 ac
Phase 2/3
480 ac
Hickory Cove Marsh Project Description
Action Area
Marsh Phase 1
Marsh Phase 2 and 3
Living Shoreline
SNWW -- Sediment Source
Containment Levee Repair
Breakwaters
0
0.25
0.5
1
Miles
N


Jacks Island
East Cane Island
West Cane Island
Vidor
90
Rose City
Pinehurst
Orange
Sassafras Island
Harbor Island
Orange Harbor Island
Big Island
Smith Island
Orangefield
Cutoff Island
62
Clark Island
Gum Island
Mule Island
347
Bridge City
366
Goat Island
Shell Island
Humble Island
Stewts Island
Sydnes Island
Nederland
Dooms Island
93
NE Hwy 69
136
Groves
Blue Island
W Port Arthur Rd
Sabine Lake
69
Pleasure Island
215
Marceaux Island
H O Mills Hwy
Island
Port Arthur
87
© 2021 Google
82
Double Island
Texaco Island

US Army Corps
of Engineers ®
Galveston District

Appendix B-2

Endangered Species Act Compliance

for

WRDA Section 1122 Beneficial Use Pilot Project, Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas

November 2021

WRDA 2016 Section 1122
Hickory Cove Marsh, Bridge City, TX
Beneficial Use Pilot Project

Biological Assessment for Federally-Listed Threatened and Endangered Species

November 2021

Prepared by:

United States Army Corps of Engineers
Regional Planning and Environmental Center

US Army Corps of Engineers ®
Galveston District

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Contents

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1.0 INTRODUCTION

This Biological Assessment (BA) has been prepared in accordance with requirements outlined under Section 7 of the Endangered Species Act (ESA). Section (7)(a)(2) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that are proposed or listed as endangered or threatened, as well as their designated critical habitat, if applicable. This BA demonstrates the proposed action is in compliance with Section 7, which assures that, through consultation with the US Fish and Wildlife Service (USFWS), Federal actions do not jeopardize the continued existence of any threatened, endangered or proposed species, or result in the destruction or adverse modification of critical habitat.

1.1 Study Background

The purpose of this BA is to address the effect of the WRDA 2016 Section 1122 Hickory Cove Marsh, Bridge City, TX Beneficial Use Pilot Study's Tentatively Selected Plan (TSP) (or proposed action) on ESA-listed species and their designated critical habitat. The U.S. Army Corps of Engineers, Galveston District (USACE), in partnership with Ducks Unlimited and the Port of Orange, is exploring the feasibility of implementing a pilot project for the beneficial use of dredged material generated during operations and maintenance dredging of the Sabine Neches Waterway (SNWW) as a means to restore degraded marsh lands.

The US Army Corps of Engineers (USACE) intends to seek authorization to fund and execute the action described below, pursuant to Section 1122 of the Water Resources Development Act of 2016 which directs the USACE to establish a pilot program to carry out 10 projects for the beneficial use of dredged material, including for the project purposes of:

- reducing storm damage to property and infrastructure;
- promoting public safety;
- protecting, restoring, and creating aquatic ecosystem habitats;
- stabilizing stream systems and enhancing shorelines;
- promoting recreation;
- supporting risk management adaptation strategies; and
- reducing the costs of dredging and dredged material placement or disposal, such as for projects that use dredged material as construction or fill material, civic improvement objectives, and other innovative uses and placement alternatives that produce public economic or environmental benefits.

This pilot project is one of ten final proposals evaluated and selected from 95 submittals because it has high environmental, economic, and social benefits, and exhibits geographic diversity.

USACE is the lead Federal agency for the proposed project and will oversee compliance with applicable federal laws and regulations required for the project as well as protection measures for sensitive biological resources.

The TSP includes features that restore and sustain the form and function of the coastal marshes in the project area. Implementation of the TSP has the potential to impact the following ESA-listed species that occur in the area: eastern black rail (L), whooping crane (*Grus americana*) West Indian manatee (*Trichechus manatus*) and the monarch butterfly (*Danaus plexippus*). No critical habitat for any of the species exists within the action area.

1.2 Consultation History

Very early in the study process, USFWS and Texas Parks and Wildlife (TPWD) were involved in identifying potential locations to beneficially use dredged material in the vicinity of the SNWW. Additionally, TPWD was present at site visits and assisted in data collection.

- 19 August 2021: Project was created in IPaC using the study area boundaries. An official species list was requested and returned from the Texas Coastal and Louisiana Ecological Services Field Offices (02ETTX00-2021-SLI-3042 and 04EL1000-2021-SLI-2249).
- 08 Sept 2021: Most recent NMFS species list for Texas was pulled (species list updated 01 Sept 2021).
- 01 October 2021: New project created in IPaC to reflect the action area and not the study area after the project had been refined and a determination was made of what the action area consisted of. An Official Species List was requested and received (Consultation Code: 02ETTX00-2022-SLI-007)
- 05 October 2021: E-mail communication with J. Culbertson to confirm accuracy of the Official Species List generated by IPaC. Species list did not include whooping crane or eastern black rail, which have both been identified as a concern during previous communications about the project. J. Culbertson recommended consideration of the two species for purposes of Section 7 compliance.

2.0 DESCRIPTION OF THE ACTION AND ACTION AREA

This section describes the proposed action including the benefits and impacts associated with implementing the action and a description of the action area. The information contained here is a summary of the overall project and impacts. Additional information, specifically regarding benefits and impacts can be found in the Draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA).

2.1 Description of the Action

The project is located within Hickory Cove Bay in an area known as "the saddle" where the Sabine and Neches rivers merge into Sabine Lake in Orange County, Texas. The project area includes 1,200 acres of impounded marsh lands and open water areas of Sabine Lake. The land is owned and operated by the Hawk Club, a private hunting club, and adjacent to the Lower Neches Wildlife Management Area (WMA) which is owned and operated by TPWD. The Sabine Neches Waterway (SNWW) is the only federal navigation project immediately near the study area (Figure 1).

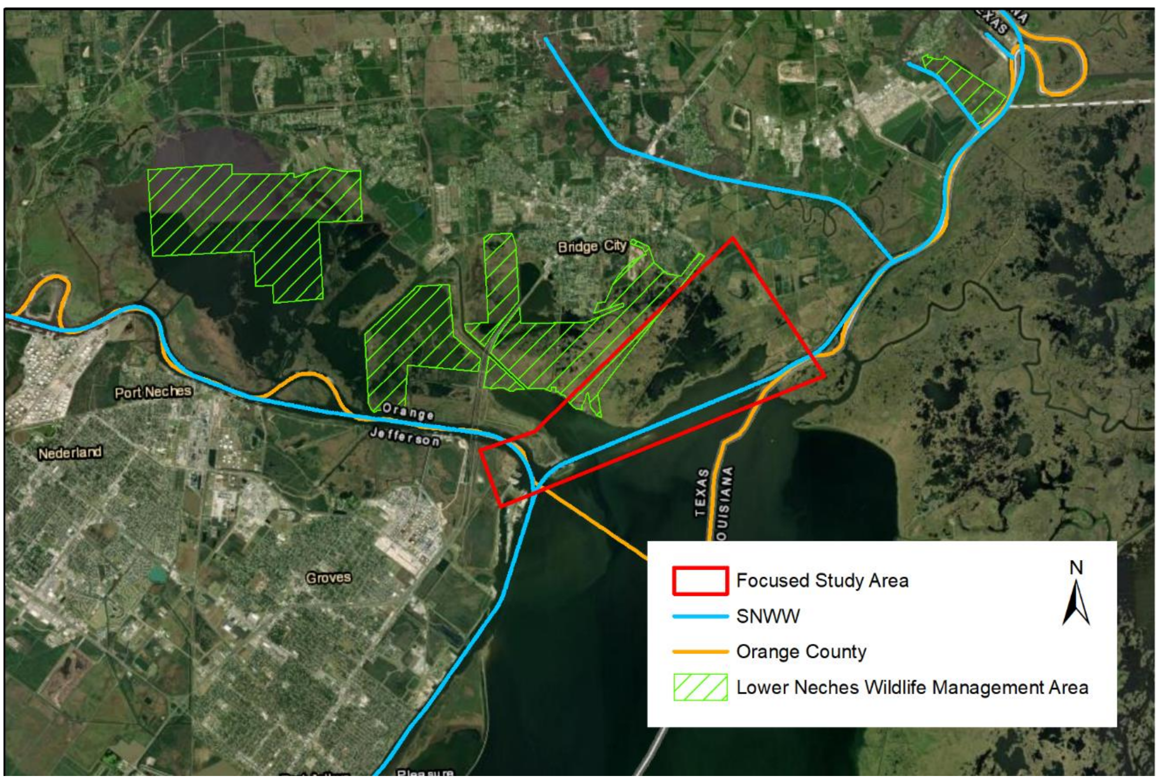

Figure 1. Study Area

Alternative 3 was chosen as the TSP (Figure 2). This plan involves beneficially using dredged material to restore up to 670 acres of marsh habitat and create resiliency against future conditions. Marsh measures consist of three phases of marsh restoration that would increase land coverage in the project area and improve terrestrial wildlife habitat, hydrology, and water quality. To protect marsh restoration efforts, the project involves repairing an existing containment that will limit hydrologic connection between Sabine Lake and the interior marsh areas to only extreme conditions and create conditions conducive for reestablishment and sustainment of marsh under future conditions. Shoreline measures include construction of rock breakwaters and living shoreline features that help to mitigate erosion, dissipate wave energies, stabilize shorelines, reduce land loss, reduce saltwater intrusion, and support reestablishment of emergent marsh through retention of sediments. Material placed into the marsh and on the existing containment levee would have similar properties to the existing native material. Under the existing and projected future dredging cycles, there is sufficient quantities of suitable material available to meet all restoration needs without seeking other borrow sources (e.g. off-shore, upland placement areas).

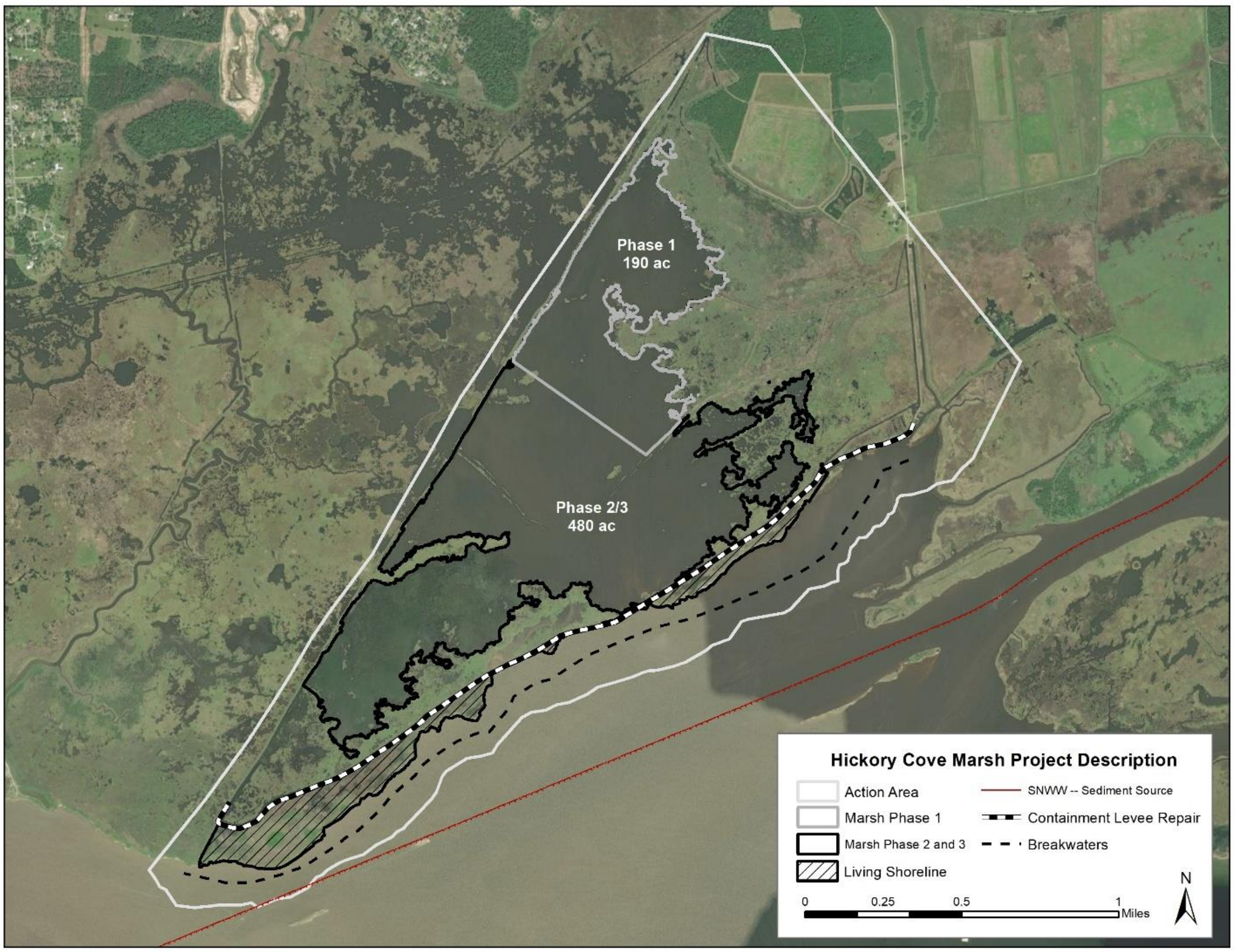

Figure 2. Project Description

Alternative 3 measures have been developed to a feasibility level of design (i.e. estimates, design level that is not detailed enough for construction) based on currently available data and information developed during plan formulation. There is significant institutional knowledge regarding the construction of the restoration measures; therefore, there is minimal uncertainty from a construction standpoint. Uncertainties relating to measure design and performance are mainly centered on site specific, design-level details (e.g. exact sediment quantities, invasive species removal needs, extent of erosion control needs, construction staging area locations, pipeline pathways, timing and duration of construction, etc.), which would be addressed during the pre-engineering and design phase (PED).

Additional plan details are provided in the Draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) and the Engineering Appendix of the DIFR-EA (Appendix A).

Marsh Restoration

Implementation of this project would involve placing approximately 3.5 million cubic yards of material dredged from the SNWW to restore approximately 670 acres emergent marsh dominated by *Spartina patens*. Placement of material would occur over three phases as funding and sediment material becomes available. Phase 1 would involve placing approximately 1.3 million cubic yards of material in the unit, while the Phase 2 and Phase 3 units would need an estimated 2.2 million cubic yards of material.

Dredged material would be hydraulically pumped into open water and low-lying areas assuming that 60 percent (%) of the restoration unit will have a post-construction settlement target elevation of +1.2 feet mean sea level (MSL) and the remaining 40% of the unit will have a target elevation of +0.5 feet MSL. Target elevations were determined based on successful vegetation establishment at the Old River Cove restoration site on the Lower Neches WMA, which was used as an ecosystem restoration reference site, and resource agency input. As necessary, temporary training berms (containment dikes) would be constructed from in-situ material around the nourished areas to efficiently achieve the desired initial construction elevation. The berms would be breached following construction to allow dewatering and settlement to the final target marsh elevation. Vegetation plantings would follow protocols and species assemblages used at the reference site.

Following marsh restoration actions, non-native/undesirable species monitoring would be implemented. If species are found, measures would be taken to stop or slow the expansion of the species within the restoration units.

Containment Levee Repair

The existing containment levee would be repaired to a uniform elevation of +5.0 feet MSL and slopes restored to 3:1 (Figure 3) to limit tidal influence and salinity intrusion into interior existing and restored marshes. Sediment for the repair would come from material placed in the marsh restoration areas.

Under the existing condition, numerous breaches in the levee allow saltwater intrusion and high energy flows which scour and cause erosion, increase land loss, and convert marsh habitat to open water.

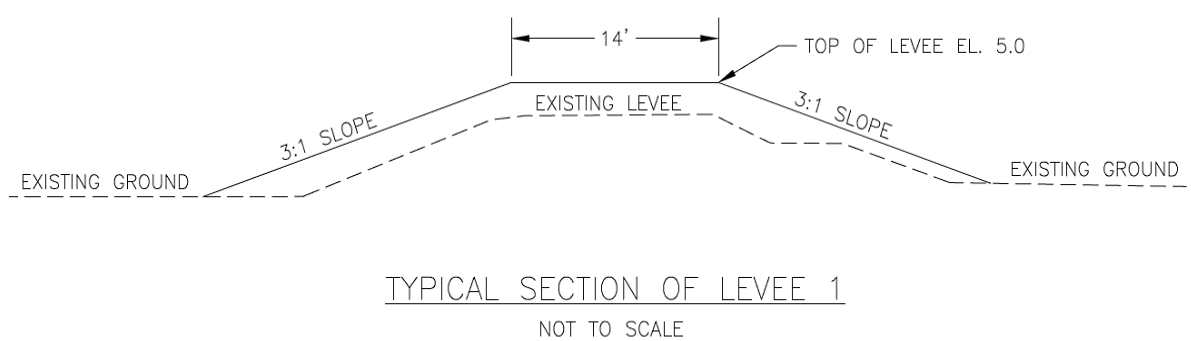

Figure 3. Typical cross-section of the repaired containment levee

Breakwaters

Approximately 14,623 linear feet (LF) (about 2.8 miles) of stone breakwaters would be constructed in shallow water (<three feet deep) at varying distances from the shoreline and where soils are conducive to supporting the weight of the stone without significant subsidence. The distance from the shoreline would be determined during PED, after site specific surveys have been completed, but sufficiently offset from the boundaries of the SNWW navigation channel to ensure continued safe navigation.

The design would be a trapezoidal structure built of approximately 138,000 tons of stone up to a height of +3.5 feet MSL, which will yield approximately 1-1.5 feet of rock exposed above the mean high tide level. Other approximate features of the design include a 4-foot wide crown, a 2:1 slope, and a base that is roughly 30 feet wide. The structure would have a total footprint of approximately 2 acres. The base of the structure would be on filter cloth ballasted to the water bottom to secure placement and prevent displacement of the outboard edges. The number of openings and width of each would be determined during PED and dependent on the location of major channel entrances or access points required for fishery access or circulation and potential for erosion to affect the existing containment levee. The preliminary design of this feature is shown in Figure 4.

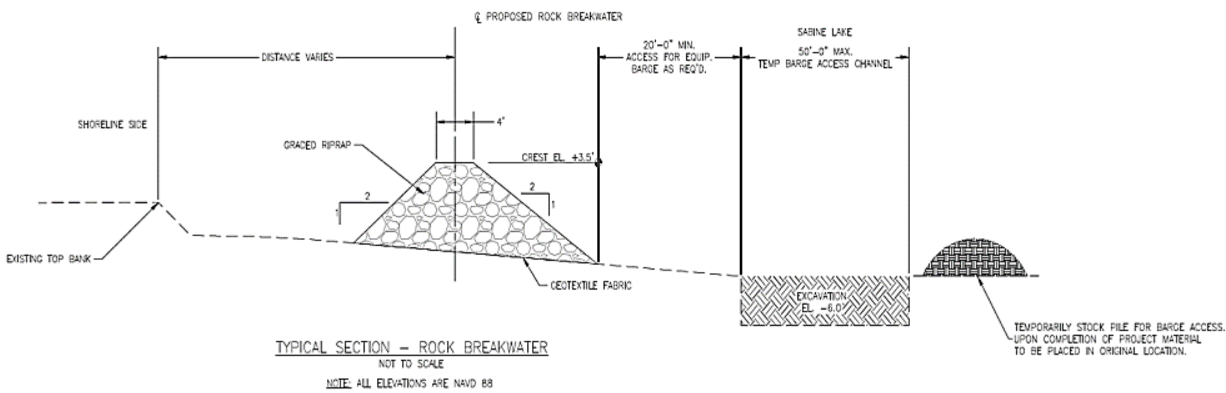

Figure 4. Typical cross-section of the breakwaters

Living Shoreline

A 95-acre living shoreline would be planted between the existing containment levee and the breakwaters. Invasive plant species, primarily Chinese tallow (*Triadica sebifera*) would be removed from the levee and smooth cordgrass (*Spartina alterniflora*) would be planted along the toe of the levee to form the living shoreline. Approximately 217,000 *S. alterniflora* plugs would be planted with 60-inch spacing. Establishment of this feature would provide toe protection to the existing containment levee and promote sediment accretion to regain lost habitat.

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Sediment transport equipment would most likely include cutterhead dredges, pipelines (submerged, floating, and land) and one booster pump. Heavy machinery would be used to move sediment and facilitate construction. Heavy equipment could include bulldozers, front-end loaders, track-hoes, marshbuggies, track-hoes, and backhoes. For breakwater construction, stone would be purchased from a commercial quarry and transported to the site by barge, where it would then be placed by crane or hopper barge. Various support equipment would also be used, such as crew and work boats, trucks, trailers, construction trailers, all-terrain vehicles, and floating docks and temporary access channels to facilitate loading and unloading of personnel and equipment.

Identification of staging areas, pipeline routes, and placement of floatation docks would occur during PED. Each disturbance for access and staging would be placed outside of environmentally sensitive areas to the greatest extent practicable and utilize areas already disturbed when possible (e.g. stage on existing agricultural bare ground, existing roadways, or mowed/pastured private lands). All ground disturbance for access and staging areas would be temporary and fully restored to result in no permanent loss.

Timing

Timing of initial construction of this project (Phase 1) is dependent on several factors including: timing of authorization, duration of the PED phase, and Federal- and non-federal funding cycles. It was assumed that construction would begin in March 2024 and have approximately 30 months of on-the-ground work (Table 1). These dates and are based on the next projected SNWW Neches River or Sabine River dredging cycle. The timing of Phase 2 and Phase 3 marsh restoration units are uncertain at this time but would not likely occur before 2027 unless an emergency dredging cycle occurs as a result of excess shoaling from a storm event.

Table 1. Anticipated construction schedule

Measure	Duration	Start	End
Dredging, Phase 1 Marsh Restoration, and Containment Levee Repair	12	Mar 2024	Feb 2025
Breakwaters	16	Mar 2025	Jul 2026
Living Shoreline	2	Mar 2027	Apr 2027

2.1.1 Benefits of the Action

The unconfined placement of dredged material in marsh restoration units and construction of other TSP features along the shoreline would have a net beneficial effect on the environment. A total of 670 acres of marsh habitat would be restored by reducing the extent of deep open water in the restoration unit, which is considered less productive than marsh habitat, and decreasing salinity in order to support fresher marsh habitats. As well, increasing available sediment in the marsh units is expected to increase the potential for accretion into the future by supporting an assemblage of desired vegetative species. Once vegetative species composition is restored, the value of the marsh habitat to avian, terrestrial, and aquatic wildlife and fish is expected to increase by providing higher quality nesting, foraging, roosting, and nursery habitat.

Hickory Cove's shoreline runs parallel to the SNWW on the northern side of Sabine Lake and is exposed to wave action that has repeatedly degraded the containment levee on the exterior of the marsh. In addition to navigation traffic subjecting the shoreline to erosive forces, Hickory Cove's shoreline is along the northern boundary of the lake with a significant fetch leaving it vulnerable to wind-driven and ship induced wave action. Attenuating waves through construction of about 2.8 miles of breakwaters and 95-acres of living shoreline was considered necessary to mitigate degradation and breach of the containment levee and subsequent marsh degradation exacerbated by these conditions.

Along the shoreline, approximately 2.8 miles of stone breakwaters would be constructed. The breakwaters allow for the stabilization and protection of the existing shoreline and also support the reestablishment of intertidal emergent vegetation along the shoreline through retention of sediments and reduced land loss. Under the existing condition, the rate of loss is approximately four feet per year, which translates to approximately 260 acres of interior marsh that would be protected and improve with implementation of the breakwaters. Additionally, breakwaters are expected to improve overall water quality with reduced saltwater intrusion and turbidity, and may decrease operations and maintenance costs of the GIWW by reducing the amount of dredging. Overall, emergent shoreline habitats and interior marshes are expected to improve thereby supporting a more diverse and productive habitat for aquatic and terrestrial species. The breakwater structure itself can provide additional aquatic habitat by facilitating formation of a reef to support a greater abundance and diversity of aquatic species. Rock substrate is expected to also provide benefits to some aquatic species by providing them a refuge from predation.

Habitat Evaluation Procedures (HEP) was used to quantify existing and future habitat quality with and without the action. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each HEP model used. For this project, the mottled duck Habitat Suitability Index (HSI) model was used. The model consists a list of variables that are considered important in characterizing habitat that supports the species. To determine the Future Without Project (FWOP) and Future With Project (FWP) habitat function, the variables in the model were modified to reflect anticipated future conditions based on historic monitoring and data results and best professional judgment. The model then determines the assumed relationship between habitat qualities (Suitability Indices) based on a specified Suitability Index graph for each variable. The model then uses a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI).

Data for the model runs primarily came from data collected at the ecosystem restoration reference site on the Lower Neches WMA; Geographic Information System (GIS) exercises analyzing land cover change over time, vegetative cover, width/length/area, etc.; from existing monitoring such as salinity and shoreline change; and existing data collected during the Sabine Pass to Galveston Bay, Texas Coastal Storm Risk Management and Ecosystem Restoration Feasibility Study or Sabine-Neches Waterway Channel Improvement Project (SNWW CIP). Results indicate that just doing phase 1 of the project would increase the quality of the action area by 291.5 average annual habitat units (AAHUs).

2.1.2 Impacts of the Action

Direct and indirect impacts associated with implementing the TSP are temporary in nature and limited in scope. Construction activities would contribute the greatest impacts to the environment and could include: localized effects to water quality, including increased turbidity and total suspended sediments, organic enrichment, reduced dissolved oxygen, elevated carbon dioxide levels, and decreased light penetration, among others; habitat removal and/or fragmentation; temporary habitat avoidance because of increased noise, dust generation, vibrations, and overall lower quality habitat; losses of slow moving and less mobile species (small mammals, aquatic invertebrates, benthic species, smaller/younger fish, and herptofauna); temporary changes in hydrologic flow; and temporary loss of recreation opportunities. The level and duration of the impacts is dependent on the final design of each restoration measure, type of equipment used, and duration of construction activities. However, it is anticipated that once construction is complete, temporary impacts related to construction activities would cease.

Although marsh restoration would result in the loss of deep open water habitat in the restoration units, wildlife species currently utilizing this habitat would not be expected to be adversely affected. Most of these species are mobile allowing them to relocate into adjacent open water habitats outside immediate placement area. The conversion of open water to marsh habitat is generally considered a benefit to aquatic species.

Under the TSP, breakwaters would convert a very narrow strip of soft bottom to a hardened structure thereby reducing available habitat for aquatic species and resulting in the loss of immobile species. However, these impacts would have an overall minimal impact to fisheries and aquatic populations in the area and would in the long-term protect adjacent habitat that aquatic species depend on for survival that would be lost in the future if the measures were not implemented. As well, the structures would be designed in such a way as to not hinder movement of aquatic species.

2.2 Description of the Action Area

The project area is along the most northern boundary of the Sabine-Neches Estuary, where the Sabine and Neches rivers enter the Sabine Lake. The estuary exhibits very complicated circulation and salinity patterns. Tidal flow originating from the Gulf, the strength and intensity of winds, intensity of rainfall and associated river inflows, and depth of the SNWW and lake strongly influence salinity in Sabine Lake and in particular the project area.

Approximately 80% of the project area is considered inland open water habitat. As described in the DIFR-EA, salinity in Sabine Lake in the project area seaward of the containment levee (breakwater location) is highly dependent on the flows of the Sabine and Neches rivers and the location of the saltwater wedge and can range from 0.0 to over 30.0 ppt with salinity more typically between 4.0 and 18.0 ppt. Here the depth of habitat is shallow (<four feet) and typically very turbid due to the two rivers merging in the project area. This area support little to no rooted vascular plants (submerged aquatic vegetation [SAV]). Phytoplankton are the most likely plant or animal species to occur in this habitat.

Salinity within the open water areas in the interior of the containment levee (marsh restoration) has much higher salinity (well over 18 ppt) because with every tidal surge that breaches the containment levee the higher salinity water gets trapped behind the containment levee and there are not sufficient freshwater flows to reduce salinities. SAV, while very limited, is found along existing marsh edges.

Marshhay cordgrass (*Spartina patens*) dominates salt marshes where marsh habitat is not being broken up by open water within and external to the containment levee. While fresh and intermediate-brackish marsh are found in the action area in the interior of the containment levee, placement of material would not occur in these habitat types.

Project area sites are used by a variety of marine, freshwater, and terrestrial fauna for resting, nesting, spawning, foraging, etc.; however, diversity and abundance is relatively low because of degraded conditions. For a complete description of species commonly found in the project area see the DIFR-EA.

3.0 LISTED SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

Four ESA-listed, candidate or proposed for listing species were identified in the USFWS Official Species List dated October 1, 2021 and an additional two species were identified by the Clear Lake Ecological Services Office as a potential species that could occur in the area despite not being on the Official Species List (Attachment A). The Official Species list noted that two of the species – piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*) – only needs to be considered for wind related projects within the migratory route. Because this is not a wind related project, these two species will not be included in the analysis. No critical habitat has been designated in the action area.

Table 2. ESA-listed Species Identified by USFWS as Potentially Occurring in the Action Area

Species	Scientific Name	Jurisdiction	Status
Birds			
Eastern black rail	*Laterallus jamaicensis jamaicensis*	USFWS	Threatened
Whooping Crane	*Grus americana*	USFWS	Endangered/ Threatened for the Non-Essential Population
Mammals			
West Indian Manatee	*Trichechus manatus*	UFWS	Threatened
Insects			
Monarch butterfly	*Danaus plexippus*	USFWS	Candidate

To assess the status of species in the action area and potential impacts of the action on ESA-listed species, several sources were consulted including: literature review of scientific data; interview of recognized experts on listed species including local and regional authorities and Federal (USFWS and National Marine Fisheries Service [NMFS]) and State (TPWD) wildlife personnel; on-site inspections; and compiled lists of ESA-listed species. Significant literature sources consulted include the USFWS and NMFS species specific webpages, Federal status reports and recovery plans, TPWD species occurrence and monitoring reports, peer-reviewed journals, and other standard references.

3.1 Eastern Black Rail

The eastern black rail is the most secretive of the secretive marsh birds and one of the least understood species in North America. The sparrow-sized bird with slate gray plumage and red eyes lives in remote wetlands of the Midwest and along the coasts of the Atlantic and Pacific oceans and the Gulf of Mexico. Because it only comes out at night, prefers to walk hidden in tall grasses instead of fly and rarely makes a call, very little is known about its behavior and habitat needs.

Not much is known about the subspecies diet, but they are probably opportunistic foragers. Their bill shape suggests generalized feeding methods such as gleaning or pecking at individual items, thus a reliance on sight for finding food. Examination of specimens collected indicates a diet of small aquatic and terrestrial invertebrates, as well as small seeds. Foraging most likely occurs on or near the edges of stand of emerging vegetation -- both above and below the high-water line.

Status

The eastern black rail was listed as threatened on October 8, 2020 with a Section 4(d) Rule (FR 63764). No critical habitat has been designated for the species. The Section 4(d) Rule allows the Service to establish prohibitions or exceptions to prohibitions for threatened species while providing for the conservation of a threatened species by allowing flexibility under ESA. None of the 4(d) Rule prohibitions or exceptions to prohibitions apply to this project.

The primary threats to eastern black rail are: (1) Habitat fragmentation and conversion, resulting in the loss of wetland habitats across the range; (2) sea level rise and tidal flooding; (3) land management practices (i.e., incompatible fire management practices, grazing, and haying/mowing/other mechanical treatment activities); and (4) stochastic events (e.g., extreme flooding, hurricanes). Human disturbance, such as birders using excessive playback calls of black rail vocalizations, is also a concern for the species. Additional stressors to the species (including oil and chemical spills and environmental contaminants; disease, specifically West Nile virus; and predation and altered food webs resulting from invasive species (fire ants, feral pigs, nutria, mongoose, and exotic reptiles) introductions.

Range and Habitat

All of the information found in this section were summarized from Watts (2016), unless otherwise indicated.

The eastern black rail is a widely distributed, secretive marsh bird with little known about its population structure and dynamics. The subspecies is broadly distributed, living in salt and freshwater marshes in portions of the United States, Central America, and South America. The species is partially migratory wintering in the southern part of its breeding range.

The eastern black rail has a broad but poorly known breeding range that includes the Atlantic and Gulf Coasts of North America, parts of Colorado, Oklahoma and the mid-west, the West Indies including Cuba, Jamaica and historically Puerto Rico and parts of Central America from Mexico through Panama. A total of 1,937 occurrence records were found within this area between 1836 and 2016. Credible evidence of occurrence was found for 21 of the 23 states including 174 counties, parishes and independent cities and 308 named properties. Based on breeding evidence and seasonality of occurrence 34 (19%) counties were classified as confirmed, 97 (56%) as probable breeding and 43 (25%) as possible breeding. Many of the named properties are well-known conservation lands including 46 (15%) national wildlife refuges, 44 (14%) state wildlife management areas, 26 (8%) state and municipal parks and many named lands managed by non-governmental conservation organizations.

Since 2010, 247 black rail occurrences have been recorded within 11 of the 23 states in the study area. Records were found for 53 counties, parishes and independent cities (Figure 7). Based on breeding evidence and seasonality of occurrence 2 (4%) counties were classified as confirmed, 35 (66%) as probable breeding and 16 (30%) as possible breeding. Records were found for 92 named properties including 2 (3%) properties classified as confirmed, 73 (79%) as probable breeding and 17 (18%) properties classified as possible breeding.

The eastern black rail is a wetland dependent bird requiring dense overhead cover and soils that are moist to saturated (occasionally dry) and interspersed with or adjacent to very shallow water (typically ≤three centimeters [cm]) to support its resource needs. Eastern black rails occur across an elevational gradient that lies between lower and wetter portions of the marsh and their contiguous uplands. Their location across this gradient may vary depending on the hydrologic conditions. These habitat gradients have gentle slopes so that wetlands are capable of having large areas of shallow inundation (sheet water). These wetlands are able to shrink and expand based on hydrologic conditions and thus provide dependable foraging habitat across the wetted areas and wetland-upland transition zone for the subspecies. Eastern black rails also require adjacent higher elevation areas (i.e., the wetland-upland transition zone) with dense cover to survive high water events due to the propensity of juvenile and adult black rails to walk and run rather than fly and chicks' inability to fly. (USFWS 2019)

The subspecies requires dense vegetation that allows movement underneath the canopy, and because are found in a variety of salt, brackish, and freshwater wetland habitats that can be tidally or non-tidally influenced, plant structure is considered more important than plant species composition in predicting habitat suitability. In terms of nest success, nests must be well hidden in a dense clump of vegetation over moist soil or shallow water to provide shelter from the elements and protection from predators. Flooding is a frequent cause of nest failure; therefore, water levels must be lower than nests during egg-laying and incubation in order for nets to be successful. In addition, shallow pools that are one to three cm deep may be the most optimal for foraging and for chick-rearing. (USFWS 2019)

Occurrence in the Action Area

All information in this section was summarized from Watt (2016) unless otherwise noted.

Texas is a black rail crossroad making it difficult to differentiate breeders from winter residents from migrants. Black rail in Texas use tidal salt marshes along the barrier islands and the mainland fringe, as well as, drier coastal prairie. The upper Texas coast (Jefferson, Chambers, Galveston, Harris, and Brazoria counties) has a long history of black rail records that are concentrated within national wildlife refuges and state wildlife management areas. Much of the black rail activity along the upper Texas coast has been concentrated on the Bolivar Peninsula and Brazoria, Anahuac and San Bernard National Wildlife Refuges. Presence of black rail in Orange county (action area) is uncertain but is presumed to be likely.

Within the action area, dredged material would be placed into open water areas and severely degraded and fragmented marsh habitat with current platform elevations of less than +0.5 feet. Adjacent to the marsh restoration units, intact marsh habitat is present and could be suitable habitat for eastern black rail.

3.2 Whooping Crane

The whooping crane (*Grus americana*) is the tallest North American bird with males approaching 1.5 meters in height, is snowy white with black primary feathers on the wings, and a bare red face and crown. Whooping cranes form monogamous pairs for life and all whooping cranes return to the same breeding territory in Wood Buffalo National Park, in Canada to nest in late April or May. Whooping cranes return to wintering grounds of Aransas National Wildlife Refuge (NWR) by late October to mid-November where they migrate singly, in pairs, in family groups or in small flocks and remain until March or April.

Whooping cranes are omnivorous and forage by probing and gleaning foods from soil, water, and vegetation. Summer goods include dragonflies, damselflies, other aquatic insects, crayfish, clams, snails, grasshoppers, cricket, frogs, mice, voles, small birds, minnows, reptiles, and berries. During the winter in Texas, they eat a wide variety of plan and animal foods, with blue crabs, clams, and berries of Carolina wolfberry (*Lycium carolinianum*) being predominant in the diet. Foods taken at upland sites include acorns, snails, crayfish, and insects. Waste grains, such as barley and wheat, form an important part of the diet during the spring and fall migrations (Lewis 1995, Campbell 2003, Canadian Wildlife Service [CWS] and USFWS 2007).

Status

The whooping crane was federally listed as endangered on March 11, 1967 (32 FR 4001). Critical habitat has been designated in Aransas, Calhoun, and Refugio counties in Texas, and includes the Aransas National Wildlife Refuge. There is no critical habitat in or near the vicinity of the project area.

The main factors for the decline of the whooping crane were loss of habitat to agriculture (hay, pastureland, and grain production), human disturbance of nesting areas, uncontrolled hunting, specimen and egg collection, collisions with power lines, fences, and other structures, loss and degradation of migration stopover habitat, disease such as avian cholera, predation, lead poisoning, and loss of genetic diversity. Biological factors, such as delayed sexual maturity and small clutch size, prevent rapid population recovery. Drought during the breeding season presents serious hazards to the species. Exposure to disease is a special problem when large numbers of birds are concentrated in limited areas, as often happens during times of drought (Lewis 1995, Campbell 2003, CWS and USFWS 2007).

Range and Habitat

Whooping cranes were originally found throughout most of North America. In the nineteenth century, the main breeding area was from the Northwest Territories to the prairie provinces in Canada, and the northern prairie states to Illinois. Only four populations of whooping cranes exist in the wild, the largest of which is the Aransas-Wood Buffalo population, which breeds in isolated marshy areas of Wood Buffalo National Park in Canada's Northwest Territories. Each fall, the entire population of whooping cranes from this national park migrates some 2,600 miles (4,183 kilometers) primarily to the Aransas NWR and adjacent areas of the central Texas coast in Aransas, Calhoun, and Refugio counties, where it overwinters in oak savannahs, salt marshes, and bays (USFWS 1995). During migration they use various stopover areas in western Canada and the American Midwest. The three other wild populations have been introduced: an eastern population that migrates between Wisconsin and Florida and two non-migratory populations, one in central Florida, the other in Louisiana.

The natural wild population of whooping cranes spends its winters at Aransas NWR, Matagorda Island, Isla San Jose, portions of Lamar Peninsula, and Welder Point on the east side of San Antonio Bay (CWS and USFWS 2007). The main stopover points in Texas for migrating birds are in the central and eastern Panhandle (USFWS 1995).

USFWS reintroduced a non-essential experimental population (NEP) to Vermillion Parish in southwestern Louisiana in 2011. The reintroduced population was designated as NEP under section 10(j) of the ESA of 1973, as amended. A NEP population is a reintroduced population believed not be essential for the survival of the species, but important for its fully recovery and eventual removal from the endangered and threatened list. Since 2011, 10-16 hatched juveniles have been released annually at White Lake Wetlands Conservation Area, and in 2016 a new release area was added 19 miles to the south at Rockefeller Wildlife Refuge. The NEP is approximately 175 miles from the action area.

Nesting habitat in northern Canada is in poorly drained regions of freshwater marshes and wet prairies interspersed with numerous potholes and narrow-wooded ridges. Whooping cranes use a variety of habitats during migration, including freshwater marshes, wet prairies, inland lakes, small farm ponds, upland grain fields, and riverine systems. Shallow flooded palustrine wetlands are used for roosting, while croplands and emergent wetlands are used for feeding. Riverine habitats, such as submerged sandbars, are often used for roosting. The principal winter habitat in Texas is brackish bays, marshes, and salt flats, although whooping cranes sometimes feed in upland sites characterized by oak mottes, grassland swales, and ponds on gently rolling sandy soils (Lewis 1995, Campbell 2003, CWS and USFWS 2007).

Occurrence in the Action Area

Members of the NEP population are known to use typical marsh habitat along with rice and crawfish fields year-round in Orange county and a nesting pair has been documented not too far from the action area. Whooping crane use of the project area is likely particularly in intact marsh areas.

3.3 West Indian Manatee

Manatees are large, elongated marine mammals with paired flippers and a large, spoon-shaped tail. They can reach lengths of over 14 feet and weights of over 3,000 pounds. Manatees are herbivores that feed opportunistically on a wide variety of submerged, floating, and emergent vegetation.

Status

USFWS listed the West Indian manatee as endangered on March 11, 1967 (32 FR 4001) and later received protection under ESA in 1973. On May 5, 2017, the species was reclassified from endangered to threatened because the endangered designation no longer reflected the status of the species at the time of reclassification (82 FR 16668). Critical habitat for the Florida manatee subspecies (*Trichechus manatus latirostris*) was designated in 1976 (41 FR 41914).

The major threats faced by manatees today are numerous. Collisions with watercraft account for an average of 24-30% of the known manatee deaths in Florida annually. Deaths attributed to water control structures and navigational locks represent four percent of known deaths.

There are also threats to their habitat as a result of intensive coastal development throughout much of the manatee's range. As well, the availability of warm-water refuges for manatee is uncertain if minimum flows and levels are not established for the natural springs on which many manatees depend and as deregulation of the power industry in Florida occurs. There are also threats from natural events such as red tide and cold events. (USFWS 2001b)

Range and Habitat

The West Indian manatee was historically found in shallow coastal waters, bays, lagoons, estuaries, rivers, and inland lakes throughout much of the tropical and sub-tropical regions of the New World Atlantic, including many of the Caribbean islands. However, at the present time, manatees are now rare or extinct in most parts of their former range. Today, manatees occur primarily in Florida and southeastern Georgia, but individuals can range as far north as Rhode Island on the Atlantic coast (Reid 1996) and as far west as Texas on the Gulf coast.

Manatees live in marine, brackish, and freshwater systems in coastal and riverine areas throughout their range. Preferred habitats include areas near the shore featuring underwater vegetation like seagrass and eelgrass. They feed along grass bed margins with access to deep water channels, where they flee when threatened. Manatees often use secluded canals, creeks, embayments, and lagoons, particularly near the mouths of coastal rivers and sloughs, for feeding, resting, cavorting, mating, and calving (Marine Mammal Commission 1986). In estuarine and brackish areas, natural and artificial fresh water sources are sought by manatees.

When ambient water temperatures drop below 68 degrees Fahrenheit in autumn and winter, manatees aggregate within the confines of natural and artificial warm-water refuges or move to the southern tip of Florida (Snow 1991). Most artificial refuges are created by warm-water outfalls from power plants or paper mills. The largest winter aggregations are at refuges in Central and Southern Florida. The northernmost natural warm-water refuge used regularly on the west coast is at Crystal River and at Blue Springs in the St. Johns River on the east coast. Most manatees return to the same warm-water refuges each year; however, some use different refuges in different years and others use two or more refuges in the same winter (Reid and Rathbun 1986, Reid et al. 1995). Many lesser known, minor aggregation sites are used as temporary thermal refuges. Most of these refuges are canals or boat basins where warmer water temperatures persist as temperatures in adjacent bays and rivers decline.

As water temperatures rise manatees disperse from winter aggregation areas. While some remain near their winter refuges, others undertake extensive travels along the coast and far up rivers and canals. On the east coast, summer sightings drop off rapidly north of Georgia (Lefebvre et al. 2001) and are rare north of Cape Hatteras (Schwartz 1995); the northernmost sighting is from Rhode Island (Reid 1996). On the west coast, sightings drop off sharply west of the Suwannee River in Florida (Marine Mammal Commission 1986). Rare sightings also have been made in the Dry Tortugas (Reynolds and Ferguson 1984) and the Bahamas (Lefebvre et al. 2001).

During the summer, manatees may be commonly found almost anywhere in Florida where water depths and access channels are greater than one to two meters (O'Shea 1988). Manatees can be found in very shallow water. In warm seasons, they usually occur alone or in pairs, although interacting groups of five to ten animals are not unusual.

Occurrence in the Action Area

The West Indian manatee historically inhabited the Laguna Madre, the Gulf, and tidally influenced portions of rivers. It is currently, however, extremely rare in Texas waters and the most recent sightings are likely individuals migrating or wandering from Mexican waters. Historical records from Texas waters include Cow Bayou (in the action area), Sabine Lake (adjacent to the action area), Copano bay, the

Bolivar Peninsula, and the mouth of the Rio Grande (Schmidly 2004, Würsig 2017). In May 2005, a live manatee appeared in the Laguna Madre near Port Mansfield (Blankinship 2005) several hundred miles south of the action area. Due to the species' extreme rarity in the action area, its presence is highly unlikely; however, with historic records from Cow Bayou and Sabine Lake, it cannot be ruled out with certainty that the species could not occur in the action area.

3.4 Monarch Butterfly

The monarch butterfly is one of the most recognizable species in North America with its iconic orange and black markings. During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily Asclepias spp.) and larvae emerge after two to five days. Larvae develop through five larval instars (intervals between molts) over a period of 9 to 18 days, feeding on milkweed and sequestering toxic cardenolides as a defense again predators. The larva pupate into chrysalis before eclosing six to 14 days later as an adult butterfly. There are multiple generations of monarchs produced during the breeding season, with most adult butterflies living approximately two to five weeks; overwintering adults enter into reproductive diapause (suspended reproduction) and live six to nine months.

Status

On December 15, 2020, the USFWS announced that listing the monarch as endangered or threatened under ESA is warranted but precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants (85 FR 81813). The monarch is now a candidate species under ESA; its status will be reviewed each year until a listing decision is made.

Threats to the monarch include loss of milkweed and nectar resources (i.e. breeding and migratory habitat) from conversion and development of grasslands and widespread use of herbicides), exposure to insecticides, availability and quality of overwintering habitat, and climate change.

Range and Habitat

The life cycle varies by geographic locations and in many regions breed year-round. While in more temperate climates, the species can migrate long distances (over 1850 miles) lasting for over two months to reach their overwintering sites.

Texas is situated between the principal breeding grounds in the north and the overwintering areas in Mexico. Monarchs funnel through Texas both in the fall and spring. During the fall, monarchs use two principal flyways. One traverses Texas in a 300-mile wide path stretch from Wichita Falls to Eagle Pass. Monarchs enter the Texas portion of this flyway during the last days of September and by early November most have passed through to Mexico. The second flyway is situated along the Texas coast and lasts roughly from the third week of October to the middle of November. Early each March overwintering monarchs begin arriving from their overwintering grounds in Mexico seeking emerging milkweeds where they lay their eggs before dying. Most of their offspring continue heading north to repopulate the eastern half of the US and southern Canada.

Adult monarch butterflies during breeding and migration require a sufficient quality and quantity of nectar from nectar blooming resources, which they feed on throughout their migration routes and at their breed grounding (spring through fall). Monarchs also need healthy and abundant milkweed (for both oviposition and larval feeding) embedded within this diverse nectaring habitat. Many monarchs use a variety of roosting trees along the fall migration route. The size and spatial arrangement of habitat patches are generally thought to be important aspects but is not well understood.

Occurrence in the Action Area

Within a couple of miles of the action area, there are grasslands, fields, and marshes that could support milkweed and nectar flowering species in the fall and spring that monarchs could use along their migration paths. Specifically in the action area, suitable habitat is absent in the open water areas and is generally very limited in the existing marsh areas with only a few nectar flowering plants sporadically growing. Common nectar plants include sea ox-eye, seaside golden rod (*Solidago sempevirens*) and salt marsh aster (*Aster tenufolius*). Milkweed, specifically swamp milkweed (*Asclepias incarnata*) is uncommon in the area.

4.0 EFFECTS OF THE PROPOSED ACTION

This chapter describes the potential effects of the proposed action on listed species.

4.1 Eastern Black Rail

The USACE has determined implementation of any of the actionable measures ***may affect but is not likely to adversely affect*** the Eastern black rail because the temporary adverse impacts are anticipated to be insignificant and discountable, especially since conservation measures have been incorporated into the plan, the overall beneficial impacts would far outweigh any negative impacts, and no work would be completed in suitable habitat.

Breakwaters

Construction of the breakwaters would have no direct effect on eastern black rail or their habitat due to the lack of suitable habitat along the alignment. Indirect effects from noise are unlikely due to the construction occurring on average about 250-300 feet from the nearest shoreline with the closest distance being about 150 feet to the shoreline.

The likelihood of the species being near the active construction zone and affected by noise from construction activities is extremely remote and is considered negligible and discountable because all of these actions are completed in or near deep water that is tidally influenced. Marsh habitat immediately adjacent to these sites (at least several hundred feet away from the active construction site) is severely eroded and in general maintains a deeper water level than is preferred by the eastern black rail. The nearest suitable habitat would be well outside the range of potential disturbance for noise; therefore, the listed actions in this section are expected to have no effect on the species.

Marsh Restoration

<u>Beneficial Effects:</u> Implementation of this action will indirectly contribute to the recovery of the species through marsh restoration and protection from future development. Marsh restoration would restore the balance between open water and vegetation and reestablish elevations that would be less tidally influenced and more conducive to foraging and breeding without concern for frequent flooding.

<u>Direct Impacts:</u> None of the prohibitions of the Section 4(d) rule are triggered through implementation of the ER measures.

Attempts would be made to avoid construction during the breeding season (March 01 through August 31). If construction must be completed during this time, in order to take advantage of the dredging windows, potential impacts to Eastern black rail include noise disturbance during foraging activities or habitat avoidance of individuals that may be present within intact marsh while construction equipment is operating in open water areas. Impacts to the species would cease after construction is complete.

The habitat where marsh restoration would be completed is considered open water or degraded marsh with more than several centimeters of continual inundation and no connectivity to upland areas making these sites unsuitable for nesting or foraging. Additionally, the containment levee is a 3:1 sloped berm that would not support any suitable habitat. However, along the perimeter of the restoration unit, existing marsh is considered suitable habitat and could support individuals. It is highly unlikely that mortality of any individuals were to occur during construction due to lack of suitable habitat; however, birds in the adjacent wetlands could be temporarily affected by the noise of the construction equipment operating in open water areas resulting in temporary habitat avoidance. The distance from the suitable habitat to the active construction zone should be sufficient enough that equipment noise (usually only one or two pieces of equipment to move sediment and the noise from the discharge pipe) would be moderated enough to not affect calling during the breeding season. Voluntary conservation measures, such as biological monitors and nest avoidance measures, have been incorporated into the plan to further minimize any potential for impacts (section 5.2).

Living Shoreline

Construction of the living shoreline does not involve construction equipment and would be limited to volunteers planting plugs and removing invasive species. Any potential disturbance to eastern black rail would be from a volunteer accidentally flushing an individual as they are walking to or from the planting site. In general, planting of the living shoreline will increase the amount of available suitable habitat and by removing brush species and planting more desirable species.

4.2 Whooping Crane

Attempts would be made to avoid construction from October 1 through April 15 when birds are most likely to be present. If construction must be completed during this time in order to take advantage of the dredging windows, potential impacts to whooping cranes include noise disturbance during foraging activities or habitat avoidance while construction equipment is operating. Impacts to the species would cease after construction is complete. It is highly unlikely that mortality of any individuals would occur during construction due to their ability to avoid the construction area. However, additional voluntary conservation measures have been incorporated into the plan and are described in section 5.3.

Implementation of this plan will indirectly contribute to recovery of the species through marsh restoration and protection from future development. The International Recovery Plan lists several recovery actions including protecting wintering habitat to accommodate expanding crane populations (CWS and US Fish and Wildlife Service 2007), which is already evidenced by the presence of NEP birds in the study area. By restoring marsh habitat at least two identified recovery actions have been addressed (1.5.3.6—Better manage deposition of dredge material, 1.5.5—Create wetland habitat). In general, marsh restoration actions would be beneficial to the whooping crane through an increase in quality foraging habitat and in the future could serve as a wintering site.

The only individuals that are likely to occur in the action area are members of the NEP population. Usually, NEP populations are treated as “threatened” species except that the ESA’s section 7 consultation regulations do not apply. However, since the birds are crossing out of the NEP boundaries, the birds are afforded full ESA protection as endangered, which includes complying with Section 7 consultation regulations. Therefore, USACE has determined the proposed action ***may affect, but is not likely to adversely affect*** the whooping crane because the temporary adverse impacts are anticipated to be insignificant and discountable, especially since conservation measures have been incorporated into the plan, and the overall beneficial impacts would far outweigh any negative impacts.

4.3 West Indian Manatee

The proposed action would not alter marine habitats or food sources, such as seagrass or other aquatic food plants, in the action area. In the rare instance that the manatee could occur in the action area, in-water work during placement of pipelines, operation of watercraft to move material or equipment, etc. could impact manatees. Impacts could include temporary habitat avoidance, exposure to underwater sound, and visual disturbances, which would all cease after construction is complete. The most extreme impact could include entrapment and/or collision with pipes, silt barriers, pumps, placement equipment, support watercraft or other in-water construction equipment. Although this is unlikely due to the extremely rare occurrence of West Indian manatee in the action area, conservation measures are being incorporated into the plan to avoid harassment and take of manatee, see Section 5.1.

Due to the rarity of the manatee in the action area and the conservation measures that would be implemented, implementation of the action ***may affect, but not adversely affect*** the West Indian manatee.

4.4 Monarch Butterfly

The proposed action would not involve placement of sediment into exiting marsh habitat; therefore, there would be no impact to existing potentially suitable habitat that may be present in the action area. Over the long-term, marsh restoration and planting of the living shoreline would increase the amount of area available for nectar producing species to establish thereby increasing suitable habitat in the action area for monarchs.

Construction is likely to occur during fall and/or spring migration. Construction activities may produce vibrations and noise that monarchs find undesirable. However, construction equipment and presence of individuals would be limited to only a couple of earth moving equipment that would not produce noise or vibration levels reaching significant distances. Therefore, any habitat avoidance would be shifted by a couple hundred feet if at all. Monarchs are known to utilize roadside patches of milkweed and flowering plants, which would produce as much or more noise than the construction equipment operating to move and place the sediment.

Due to the lack of suitable habitat immediately in the active construction area and an anticipated undetectable level of habitat avoidance if an individual happens to be present, implementation of the action would have ***no effect*** on the monarch butterfly.

5.0 VOLUNTARY CONSERVATION MEASURES AND MONITORING

5.1 General Conservation Measures

The following conservation measures would be incorporated into operations for the protection of all listed species:

- All personnel (contractors, workers, etc.) will attend training sessions prior to the initiation of, or their participation in, project work activities. Training will include: 1) recognition of eastern black rail, whooping crane, and West Indian manatee, their habitat, and sign; 2) impact avoidance measures; 3) reporting criteria; 4) contact information for rescue agencies in the area; and 5) penalties of violating the ESA.
- Project equipment and vehicles transiting between the staging area and restoration site will be minimized to the extent practicable, including but not limited to using designated routes and confining vehicle access to the immediate needs of the project.
- The contractor will coordinate and sequence work to minimize the frequency and density of vehicular traffic within and near the restoration unit(s) and limit driving to the greatest extent practicable.
- Use of construction lighting at night shall be minimized, directed toward the construction activity area, and shielded from view outside of the project area to the maximum extent practicable.
- A designated monitor(s) will be identified who will act as the single point of contact responsible for communicating and reporting endangered species issues throughout the construction period.

5.2 Eastern Black Rail

The following conservation measures would be implemented to minimize the potential for adverse effects to Eastern black rail:

- No marsh construction activities will occur from March 1st through September 30th (breeding, nesting, chick rearing, and molting season). If this timing restriction cannot be achieved, then the following will take place:
  - On site vegetative field surveys will be conducted before work begins to identify black rail habitat types along the GIWW adjacent to the proposed breakwater structures.
  - No material for marsh restoration will be placed in high marsh dominated by gulf cordgrass (*Spartina spartinea*), saltmeadow cordgrass (*S. patens*), sea-oxeye (*Borrichia frutescens*), and/or saltgrass (*Distichlis spicata*) or dense overhead cover that meets the target marsh elevation for black rail habitat.

- If temporary access routes, pipeline routes, or staging areas occur within identified black rail habitat the contractor must minimize traffic in these areas therefore minimizing the construction footprint (i.e. limited paths).
- In addition to minimizing access routes, areas of high marsh habitat should be left intact to provide refugia for the black rail to ensure escape access routes. The USACE will work with the Service to identify refugia areas once site specific planning begins.
- Biological monitors are required to assist construction crews with avoidance and minimization of black rail habitats once work begins.

- Tidal connections must not be restricted such that the flow and salinity regimes are modified.
- Use of construction lighting at night shall be minimized, directed toward the construction activity area, and shielded from view outside of the project area.

5.3 Whooping Crane

The following conservation measures would be implemented to minimize the potential for adverse effect to whooping crane:

- Seasonal timing restriction between January 15th and June 15th in which construction should be avoided if possible. If the seasonal timing restriction cannot be avoided:
    - A biological monitor qualified in identifying whooping cranes and with stop work authority will be on site while construction is in progress.
    - A 1,000 foot-radius of the work site would be delineated before work begins. If a whooping crane is observed within the 1,000-foot radius, the biological monitor shall halt construction activities, including shutting down any running equipment until the bird has vacated the radius.
    - If construction equipment is over 15 feet tall, the equipment must be marked with visual flagging as bird avoidance measures when equipment is in use and laid horizontally on the ground when not in use.
- Workers, temporary or permanent, should be educated on the importance and protections allocated to this species, including but not limited to: no collection of features or eggs, and do not touch or harass birds.
- All whooping crane sightings should be immediately reported to the Texas Coastal ES Field Office at 281-286-8282; Wade Harrel (Service Species Lead) at Wade_Harrell@fws.gov, Trey Barron (TPWD) at Trey.Barron@tpwd.texas.gov, and Eva Szyszkoski (Louisiana Wildlife and Fisheries Department) at ESzyszkoski@wlf.la.gov or by phone at (337) 536-9596.

5.4 West Indian Manatee

The following conservation measures would be implemented to minimize the potential for adverse effects to manatees:

- Qualified biologists will monitor for the presence of manatee during phases which involve open water areas capable of supporting manatees.
- Before activities occur in open water areas, a 50-foot radius of the work area should be delineated. If a manatee is observed within the 50-foot radius, the biological monitor shall halt construction activities, including shutting down any running equipment until the animal has moved beyond the radius, either through sighting or by waiting until enough time has elapsed (approximately 15 minutes) to assume that the animal has moved beyond the buffer.
- If a manatee is sighted within 100 yards of the active work zone, vessels will operate at no wake/idle speeds.
- If siltation barriers are used, they will be made of material in which manatees cannot become entangled, should be properly secured, and regularly monitored to avoid entrapment. Barrier should not impede manatee movement.
- Any manatee sightings will be immediately reported to the USFWS Houston Ecological Services Office.

No additional monitoring would be required pre- or post-construction, due to the extremely low potential for the species to occur in the action area.

6.0 CONCLUSION

Based upon the findings of this BA, USACE has made the following effects determination for species that were identified as occurring or potentially occurring in the action area:

Species	Scientific Name	Jurisdiction	Effect Determination
Birds			
Eastern black rail	*Laterallus jamaicensis jamaicensis*	USFWS	NLAA
Whooping Crane	*Grus americana*	USFWS	NLAA
Mammals			
West Indian Manatee	*Trichechus manatus*	UFWS	NLAA
Insects			
Monarch Butterfly	*Danaus plexippus*	USFWS	No effect

NLAA= Not likely to adversely affect

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Appendix A: Species List Request

Texas

Threatened and Endangered Species and Critical Habitats Under NOAA Fisheries Jurisdiction

Species	Listing Status	Recovery Plan	Critical Habitat
Green sea turtle	Threatened - North and South Atlantic Distinct Population Segment (81 FR 20057; April 6, 2016)	October 1991	63 FR 46693; September 2, 1998
Kemp's ridley sea turtle	Endangered (35 FR 18319; December 2, 1970)	September 2011	None
Leatherback sea turtle	Endangered (35 FR 8491; June 2, 1970)	April 1992	44 FR 17710; March 23, 1979
Loggerhead sea turtle	Threatened - Northwest Atlantic Ocean Distinct Population Segment (76 FR 58868; September 22, 2011)	December 2008	79 FR 39856; July 10, 2014
Hawksbill sea turtle	Endangered (35 FR 8491; June 2, 1970)	December 1993	63 FR 46693; September 2, 1998
Oceanic whitetip shark	Threatened (83 FR 4153; January 30, 2018)	2018 Recovery Outline	None
Giant manta ray	Threatened (83 FR 2916; January 22, 2018)	December 2019 Recovery Outline	None
Fin whale	Endangered (35 FR 18319; December 2, 1970)	August 2010	None
Sperm whale	Endangered (35 FR 18319; December 2, 1970)	December 2010	None
Sei whale	Endangered (35 FR 12222; December 2, 1970)	December 2011	None
Rice's whale[1] [1] **FINAL RULE TO REVISE TAXONOMY AND COMMON NAME (86 FR 47022, 08/23/2021)**	Endangered (84 FR 15446, April 15, 2019)	September 2020 Recovery Outline	None

Last updated by Southeast Regional Office on September 01, 2021

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Texas Coastal Ecological Services Field Office
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Corpus Christi, TX 78411
Phone: (281) 286-8282 Fax: (281) 488-5882
http://www.fws.gov/southwest/es/TexasCoastal/
http://www.fws.gov/southwest/es/ES_Lists_Main2.html

In Reply Refer To: October 01, 2021
Consultation Code: 02ETTX00-2022-SLI-0007
Event Code: 02ETTX00-2022-E-00026
Project Name: Sec. 1122 BU of Dredged Material Pilot Program: Hickory Cove Marsh Restoration and Living Shoreline

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The U.S. Fish and Wildlife Service (Service) field offices in Clear Lake, Tx, and Corpus Christi, Tx, have combined administratively to form the Texas Coastal Ecological Services Field Office. A map of the Texas Coastal Ecological Services Field Office area of responsibility can be found at: http://www.fws.gov/southwest/es/TexasCoastal/Map.html. All project related correspondence should be sent to the field office responsible for the area in which your project occurs. For projects located in southeast Texas please write to: Field Supervisor; U.S. Fish and Wildlife Service; 17629 El Camino Real Ste. 211; Houston, Texas 77058. For projects located in southern Texas please write to: Field Supervisor; U.S. Fish and Wildlife Service; P.O. Box 81468; Corpus Christi, Texas 78468-1468. For projects located in six counties in southern Texas (Cameron, Hidalgo, Starr, Webb, Willacy, and Zapata) please write: Santa Ana NWR, ATTN: Ecological Services Sub Office, 3325 Green Jay Road, Alamo, Texas 78516.

The enclosed species list identifies federally threatened, endangered, and proposed to be listed species; designated critical habitat; and candidate species that may occur within the boundary of your proposed project and/or may be affected by your proposed project.

New information from updated surveys, changes in the abundance and distribution of species, changes in habitat conditions, or other factors could change the list. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS-IPaC website http://ecos.fws.gov/ipac/ at regular intervals during project planning and implementation for updates to species list and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

Candidate species have no protection under the Act but are included for consideration because they could be listed prior to the completion of your project. The other species information should help you determine if suitable habitat for these listed species exists in any of the proposed project areas or if project activities may affect species on-site, off-site, and/or result in "take" of a federally listed species.

"Take" is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. In addition to the direct take of an individual animal, habitat destruction or modification can be considered take, regardless of whether it has been formally designated as critical habitat, if the activity results in the death or injury of wildlife by removing essential habitat components or significantly alters essential behavior patterns, including breeding, feeding, or sheltering.

Section 7

Section 7 of the Act requires that all Federal agencies consult with the Service to ensure that actions authorized, funded or carried out by such agencies do not jeopardize the continued existence of any listed threatened or endangered species or adversely modify or destroy critical habitat of such species. It is the responsibility of the Federal action agency to determine if the proposed project may affect threatened or endangered species. If a "may affect" determination is made, the Federal agency shall initiate the section 7 consultation process by writing to the office that has responsibility for the area in which your project occurs.

Is not likely to adversely affect - the project may affect listed species and/or critical habitat; however, the effects are expected to be discountable, insignificant, or completely beneficial. Certain avoidance and minimization measures may need to be implemented in order to reach this level of effects. The Federal agency or the designated non-Federal representative should seek written concurrence from the Service that adverse effects have been eliminated. Be sure to include all of the information and documentation used to reach your decision with your request for concurrence. The Service must have this documentation before issuing a concurrence.

Is likely to adversely affect - adverse effects to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial. If the overall effect of the proposed action is beneficial to the listed species but also is likely to cause some adverse effects to individuals of that species, then the proposed action "is likely to adversely affect" the listed species. An "is likely to adversely affect" determination requires the Federal action agency to initiate formal section 7 consultation with this office.

No effect - the proposed action will not affect federally listed species or critical habitat (i.e., suitable habitat for the species occurring in the project county is not present in or adjacent to the action area). No further coordination or contact with the Service is necessary. However, if the project changes or additional information on the distribution of listed or proposed species becomes available, the project should be reanalyzed for effects not previously considered.

Regardless of your determination, the Service recommends that you maintain a complete record of the evaluation, including steps leading to the determination of affect, the qualified personnel conducting the evaluation, habitat conditions, site photographs, and any other related articles.

Please be advised that while a Federal agency may designate a non-Federal representative to conduct informal consultations with the Service, assess project effects, or prepare a biological assessment, the Federal agency must notify the Service in writing of such a designation. The Federal agency shall also independently review and evaluate the scope and contents of a biological assessment prepared by their designated non-Federal representative before that document is submitted to the Service.

The Service's Consultation Handbook is available online to assist you with further information on definitions, process, and fulfilling Act requirements for your projects at: http://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf

Section 10

If there is no federal involvement and the proposed project is being funded or carried out by private interests and/or non-federal government agencies, and the project as proposed may affect listed species, a section 10(a)(1)(B) permit is recommended. The Habitat Conservation Planning Handbook is available at: http://www.fws.gov/endangered/esa-library/pdf/HCP_Handbook.pdf

Service Response

Please note that the Service strives to respond to requests for project review within 30 days of receipt, however, this time period is not mandated by regulation. Responses may be delayed due to workload and lack of staff. Failure to meet the 30-day timeframe does not constitute a concurrence from the Service that the proposed project will not have impacts to threatened and endangered species.

Proposed Species and/or Proposed Critical Habitat

While consultations are required when the proposed action may affect listed species, section 7(a)(4) was added to the ESA to provide a mechanism for identifying and resolving potential conflicts between a proposed action and proposed species or proposed critical habitat at an early planning stage. The action agency should seek conference from the Service to assist the action agency in determining effects and to advise the agency on ways to avoid or minimize adverse effect to proposed species or proposed critical habitat.

Candidate Species

Candidate species are species that are being considered for possible addition to the threatened and endangered species list. They currently have no legal protection under the ESA. If you find you have potential project impacts to these species the Service would like to provide technical assistance to help avoid or minimize adverse effects. Addressing potential impacts to these species at this stage could better provide for overall ecosystem healh in the local area and ay avert potential future listing.

Several species of freshwater mussels occur in Texas and four are candidates for listing under the ESA. The Service is also reviewing the status of six other species for potential listing under the ESA. One of the main contributors to mussel die offs is sedimentation, which smothers and suffocates mussels. To reduce sedimentation within rivers, streams, and tributaries crossed by a project, the Service recommends that that you implement the best management practices found at: http://www.fws.gov/southwest/es/TexasCoastal/FreshwaterMussels.html.

Candidate Conservation Agreements (CCAs) or Candidate Conservation Agreements with Assurances (CCAAs) are voluntary agreements between the Service and public or private entities to implement conservation measures to address threats to candidate species. Implementing conservation efforts before species are listed increases the likelihood that simpler, flexible, and more cost-effective conservation options are available. A CCAA can provide participants with assurances that if they engage in conservation actions, they will not be required to implement additional conservation measures beyond those in the agreement. For additional information on CCAs/CCAAs please visit the Service's website at http://www.fws.gov/endangered/what-we-do/cca.html.

Migratory Birds

The Migratory Bird Treaty Act (MBTA) implements various treaties and conventions for the protection of migratory birds. Under the MBTA, taking, killing, or possessing migratory birds is unlawful. Many may nest in trees, brush areas or other suitable habitat. The Service recommends activities requiring vegetation removal or disturbance avoid the peak nesting period of March through August to avoid destruction of individuals or eggs. If project activities must be conducted during this time, we recommend surveying for active nests prior to commencing work. A list of migratory birds may be viewed at http://www.fws.gov/migratorybirds/regulationspolicies/mbta/mbtandx.html.

The bald eagle (*Haliaeetus leucocephalus*) was delisted under the Act on August 9, 2007. Both the bald eagle and the goden eagle (*Aquila chrysaetos*) are still protected under the MBTA and BGEPA. The BGEPA affords both eagles protection in addition to that provided by the MBTA, in particular, by making it unlawful to "disturb" eagles. Under the BGEPA, the Service may issue limited permits to incidentally "take" eagles (e.g., injury, interfering with normal breeding, feeding, or sheltering behavior nest abandonment). For more information on bald and golden eagle management guidlines, we recommend you review information provided at http://www.fws.gov/midwest/eagle/pdf/NationalBaldEagleManagementGuidelines.pdf.

The construction of overhead power lines creates threats of avian collision and electrocution. The Service recommends the installation of underground rather than overhead power lines whenever possible. For new overhead lines or retrofitting of old lines, we recommend that project developers implement, to the maximum extent practicable, the Avian Power Line Interaction Committee guidelines found at http://www.aplic.org/.

Meteorological and communication towers are estimated to kill millions of birds per year. We recommend following the guidance set forth in the Service Interim Guidelines for Recommendations on Communications Tower Siting, Constructions, Operation and Decommissioning, found online at: http://www.fws.gov/habitatconservation/communicationtowers.html, to minimize the threat of avian mortality at these towers.

Monitoring at these towers would provide insight into the effectiveness of the minimization measures. We request the results of any wildlife mortality monitoring at towers associated with this project.

We request that you provide us with the final location and specifications of your proposed towers, as well as the recommendations implemented. A Tower Site Evaluation Form is also available via the above website; we recommend you complete this form and keep it in your files. If meteorological towers are to be constructed, please forward this completed form to our office.

More information concerning sections 7 and 10 of the Act, migratory birds, candidate species, and landowner tools can be found on our website at: http://www.fws.gov/southwest/es/TexasCoastal/ProjectReviews.html.

Wetlands and Wildlife Habitat

Wetlands and riparian zones provide valuable fish and wildlife habitat as well as contribute to flood control, water quality enhancement, and groundwater recharge. Wetland and riparian vegetation provides food and cover for wildlife, stabilizes banks and decreases soil erosion. These areas are inherently dynamic and very sensitive to changes caused by such activities as overgrazing, logging, major construction, or earth disturbance. Executive Order 11990 asserts that each agency shall provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial value of wetlands in carrying out the agency's responsibilities. Construction activities near riparian zones should be carefully designed to minimize impacts. If vegetation clearing is needed in these riparian areas, they should be re-vegetated with native wetland and riparian vegetation to prevent erosion or loss of habitat. We recommend minimizing the area of soil scarification and initiating incremental re-establishment of herbaceous vegetation at the proposed work sites. Denuded and/or disturbed areas should be re-vegetated with a mixture of native legumes and grasses. Species commonly used for soil stabilization are listed in the Texas Department of Agriculture's (TDA) Native Tree and Plant Directory, available from TDA at P.O. Box 12847, Austin, Texas 78711. The Service also urges taking precautions to ensure sediment loading does not occur to any receiving streams in the proposed project area. To prevent and/or minimize soil erosion and compaction associated with construction activities, avoid any unnecessary clearing of vegetation, and follow established rights-of-way whenever possible. All machinery and petroleum products should be stored outside the floodplain and/or wetland area during construction to prevent possible contamination of water and soils.

Wetlands and riparian areas are high priority fish and wildlife habitat, serving as important sources of food, cover, and shelter for numerous species of resident and migratory wildlife. Waterfowl and other migratory birds use wetlands and riparian corridors as stopover, feeding, and nesting areas. We strongly recommend that the selected project site not impact wetlands and riparian areas, and be located as far as practical from these areas. Migratory birds tend to concentrate in or near wetlands and riparian areas and use these areas as migratory flyways or corridors. After every effort has been made to avoid impacting wetlands, you anticipate unavoidable wetland impacts will occur; you should contact the appropriate U.S. Army Corps of Engineers office to determine if a permit is necessary prior to commencement of construction activities.

If your project will involve filling, dredging, or trenching of a wetland or riparian area it may require a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (COE). For permitting requirements please contact the U.S. Corps of Engineers, District Engineer, P.O. Box 1229, Galveston, Texas 77553-1229, (409) 766-3002.

Beneficial Landscaping

In accordance with Executive Order 13112 on Invasive Species and the Executive Memorandum on Beneficial Landscaping (42 C.F.R. 26961), where possible, any landscaping associated with project plans should be limited to seeding and replanting with native species. A mixture of grasses and forbs appropriate to address potential erosion problems and long-term cover should be planted when seed is reasonably available. Although Bermuda grass is listed in seed mixtures, this species and other introduced species should be avoided as much as possible. The Service also recommends the use of native trees, shrubs, and herbaceous species that are adaptable, drought tolerant and conserve water.

State Listed Species

The State of Texas protects certain species. Please contact the Texas Parks and Wildlife Department (Endangered Resources Branch), 4200 Smith School Road, Austin, Texas 78744 (telephone 512/389-8021) for information concerning fish, wildlife, and plants of State concern or visit their website at: http://www.tpwd.state.tx.us/huntwild/wild/wildlife_diversity/texas_rare_species/listed_species/.

If we can be of further assistance, or if you have any questions about these comments, please contact 281/286-8282 if your project is in southeast Texas, or 361/994-9005, ext. 246, if your project is in southern Texas. Please refer to the Service consultation number listed above in any future correspondence regarding this project.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Texas Coastal Ecological Services Field Office
4444 Corona Drive, Suite 215
Corpus Christi, TX 78411
(281) 286-8282

Project Summary

Consultation Code: 02ETTX00-2022-SLI-0007
Event Code: Some(02ETTX00-2022-E-00026)
Project Name: Sec. 1122 BU of Dredged Material Pilot Program: Hickory Cove Marsh Restoration and Living Shoreline
Project Type: LAND - RESTORATION / ENHANCEMENT
Project Description: Alternative 3 was selected as the Tentatively Selected Plan (TSP). This plan incorporates marsh and shoreline restoration features which are critical to the stabilization and sustainment of the critical marsh resources now and into the future. Marsh measures consist of using about 3.5 million cubic yards of maintenance dredged material to nourish up to 670 acres of marsh in 3 restoration units to increase land coverage in the area and improve terrestrial wildlife habitat, hydrology, water quality, and fish nurseries. The marsh will be nourished to an elevation conducive to support Spartina patens (60% of the restoration unit will have a post-construction settlement target elevation of +1.2 feet mean sea level (MSL) and the remaining 40% of the unit will have a target elevation of +0.5 feet MSL). Additionally, in-situ material would be used to repair breaches in the existing containment levee to restore a uniform +5.0 ft MSL and 3:1 slopes.

Shoreline measures include construction of a rock breakwater structure and a living shoreline that would mitigate some effects erosion along the the shoreline. Approximately 14,623 LF of stone breakwater structures, modeled after the existing Ducks Unlimited designs, would be constructed on approximately 2.0 acres of shallow (<3 ft) submerged land to dissipate wave energies, stabilize shorelines, reduce land loss, reduce saltwater intrusion, and support reestablishment of emergent marsh along the shoreline through retention of sediments. The 95-acre living shoreline feature involves removing invasive species and planting the seaward face with salinity tolerant vegetation (primarily Spartina alterniflora) as it will be exposed to the Sabine Lake estuary. This living shoreline will armor the containment levee from future breaches and restore lost brackish and saline marshes as well as promote accretion of sediments.

The marsh restoration, repairs of the existing containment levee, and the living shoreline would be constructed on private lands, while the breakwaters would be constructed on State Submerged lands of Sabine Lake. Timing of initial construction of this project (Phase 1) is dependent on several factors including: timing of authorization, duration of the PED phase, and Federal- and non-federal funding cycles. It was assumed that construction would begin in March 2024 and have approximately 30 months of on-the-ground work. These dates and are based on the next projected SNWW Neches River or Sabine River dredging cycle. The timing of Phase 2 and Phase 3 marsh restoration units are uncertain at this time but would not likely occur before 2027 unless an emergency dredging cycle occurs as a result of excess shoaling from a storm event.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@29.99809705,-93.80269891146519,14z

Counties: Orange County, Texas

Endangered Species Act Species

There is a total of 4 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 2 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
West Indian Manatee *Trichechus manatus* There is **final** critical habitat for this species. The location of the critical habitat is not available. ***This species is also protected by the Marine Mammal Protection Act, and may have additional consultation requirements.*** Species profile: https://ecos.fws.gov/ecp/species/4469	Threatened

Birds

NAME	STATUS
Piping Plover *Charadrius melodus* Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. The location of the critical habitat is not available. This species only needs to be considered under the following conditions: ▪ Wind related projects within migratory route. Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. This species only needs to be considered under the following conditions: ▪ Wind related projects within migratory route. Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

US Army Corps
of Engineers ®
Galveston District

Appendix B-4

Coastal Zone Management Act Compliance

for

WRDA Section 1122 Beneficial Use Pilot Project, Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas

November 2021

WRDA Section 1122 Beneficial Use Pilot Project, Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas

Texas Coastal Management Plan Consistency Determination

November 2021

US Army Corps of Engineers ®
Galveston District

Prepared by:

United States Army Corps of Engineers
Regional Planning and Environmental Center

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INTRODUCTION

The U.S. Army Corps of Engineers, Galveston District (USACE), in partnership with Ducks Unlimited and the Port of Orange, is exploring the feasibility of implementing a pilot project for the beneficial use of dredged material generated during operations and maintenance dredging of the Sabine Neches Waterway (SNWW) as means to restore degraded marsh lands. This project is one of ten final proposals evaluated and selected from 95 submittals because it has a high environmental, economic, and social benefits, and exhibited geographic diversity.

The project is located within Hickory Cove Bay in an area known as “the saddle” where the Sabine and Neches rivers merge into Sabine Lake in Orange County, Texas. The project area includes 1,200 acres of impounded marsh lands and open water areas of Sabine Lake. The land is owned and operated by the Hawk Club, a private hunting club, and adjacent to the Lower Neches Wildlife Management Area (WMA) which is owned and operated by Texas Parks and Wildlife Department (TPWD). The Sabine Neches Waterway (SNWW) is the only federal navigation project immediately near the study area (Figure 1).

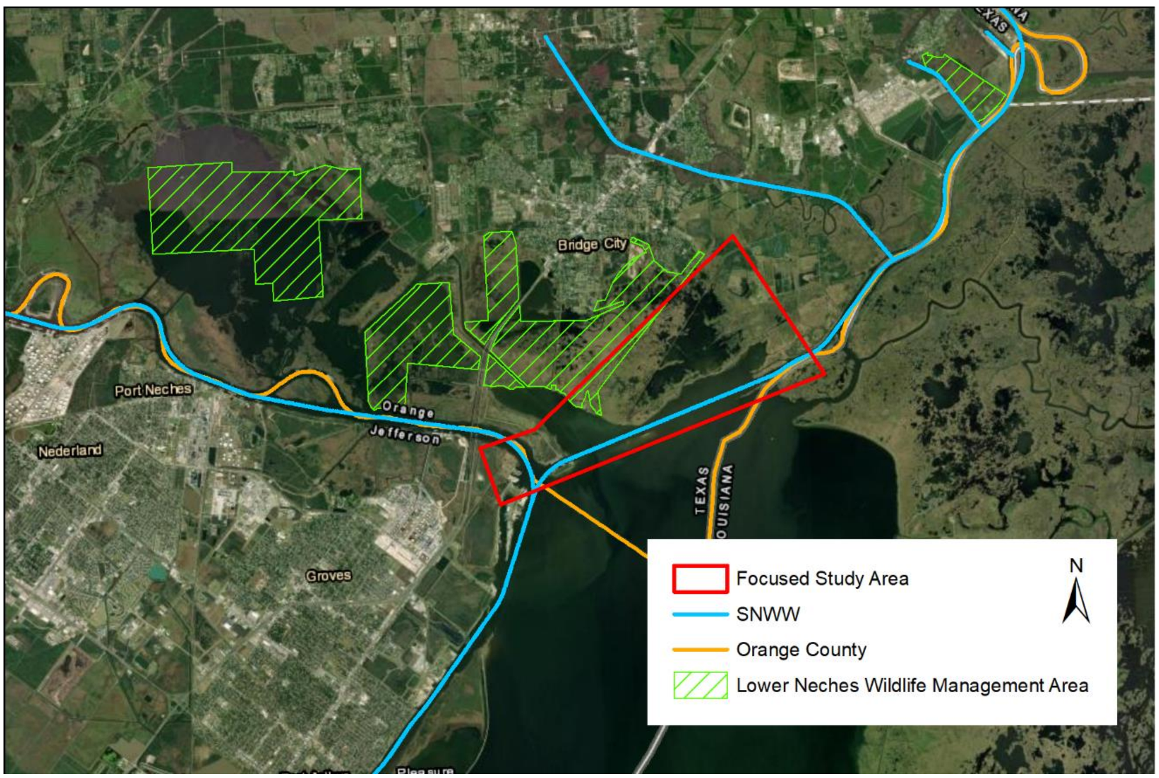

Figure 1. Study Area

Alternative 3 was chosen as the tentatively selected plan (TSP) (Figure 2). This plan involves beneficially using dredged material to restore up to 670 acres of marsh habitat and create resiliency against future conditions. Marsh measures consist of three phases of marsh restoration that would increase land coverage in the project area and improve terrestrial wildlife habitat, hydrology, and water quality. To protect marsh restoration efforts, the project involves repairing an existing containment that will limit hydrologic connection between Sabine Lake and the interior marsh areas to only extreme conditions and create conditions conducive for reestablishment and sustainment of marsh under future conditions.

Shoreline measures include construction of rock breakwaters and living shoreline features that help to mitigate erosion, dissipate wave energies, stabilize shorelines, reduce land loss, reduce saltwater intrusion, and support reestablishment of emergent marsh through retention of sediments. Material placed into the marsh and on the existing containment levee would have similar properties to the existing native material. Under the existing and projected future dredging cycles, there is sufficient quantities of suitable material available to meet all restoration needs without seeking other borrow sources (e.g. off-shore, upland placement areas).

Alternative 3 measures have been developed to a feasibility level of design (i.e. estimates, design level that is not detailed enough for construction) based on currently available data and information developed during plan formulation. There is significant institutional knowledge regarding the construction of the restoration measures; therefore, there is minimal uncertainty from a construction standpoint. Uncertainties relating to measure design and performance are mainly centered on site specific, design-level details (e.g. exact sediment quantities, invasive species removal needs, extent of erosion control needs, construction staging area locations, pipeline pathways, timing and duration of construction, etc.), which would be addressed during the pre-engineering and design phase (PED). Additional plan details are provided in the Draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) and the Engineering Appendix of the DIFR-EA (Appendix A).

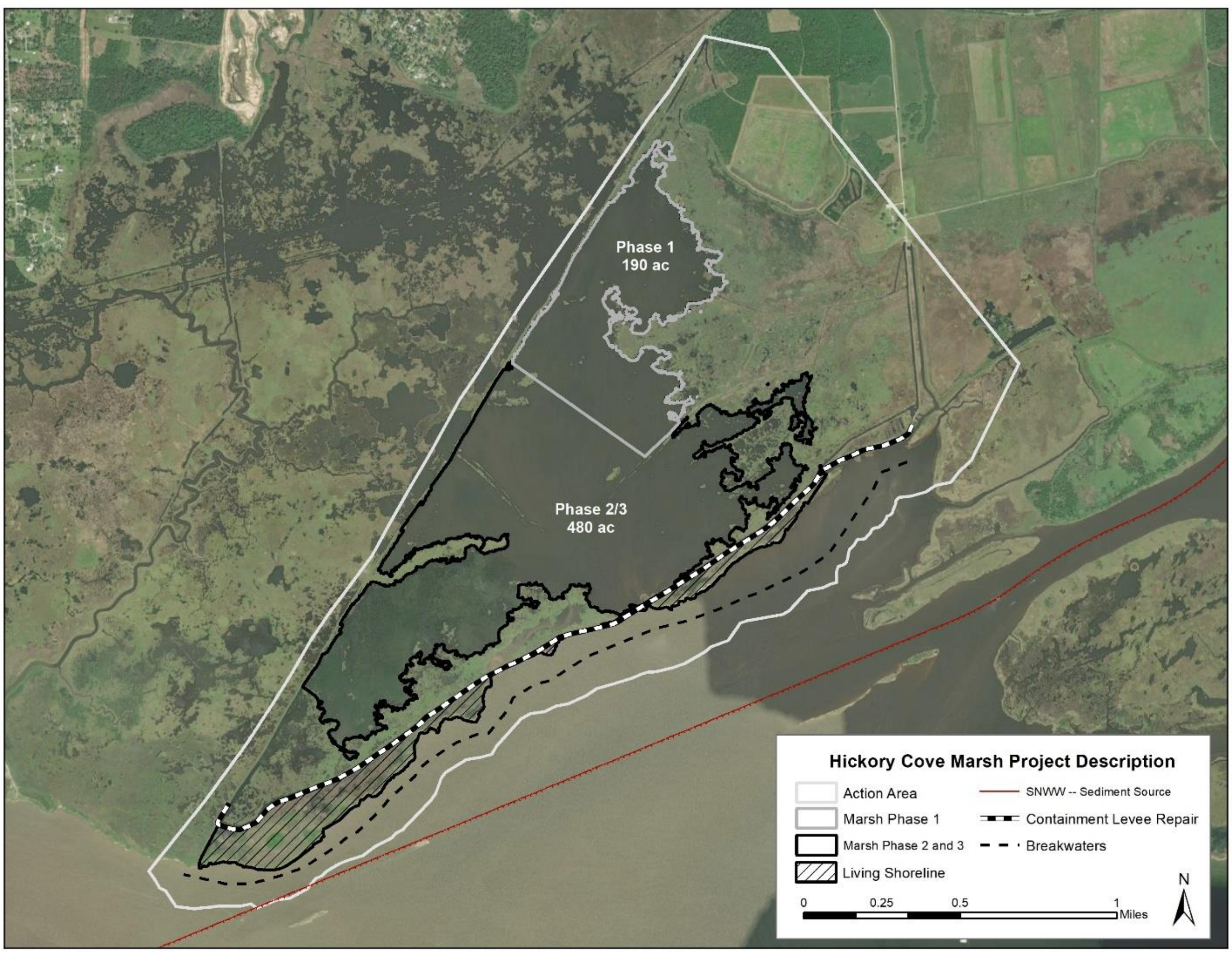

Figure 2. Project Description

Marsh Restoration

Implementation of this project would involve placing approximately 3.5 million cubic yards of material dredged from the SNWW to restore approximately 670 acres emergent marsh dominated by *Spartina patens*. Placement of material would occur over three phases as funding and sediment material becomes available. Phase 1 would involve placing approximately 1.3 million cubic yards of material in the unit, while the Phase 2 and Phase 3 units would need an estimated 2.2 million cubic yards of material.

Dredged material would be hydraulically pumped into open water and low-lying areas assuming that 60% of the restoration unit will have a post-construction settlement target elevation of +1.2 feet mean sea level (MSL) and the remaining 40% of the unit will have a target elevation of +0.5 feet MSL. Target elevations were determined based on successful vegetation establishment at the Old River Cove restoration site on the Lower Neches WMA, which was used as an ecosystem restoration reference site, and resource agency input. As necessary, temporary training berms (containment dikes) would be constructed from in-situ material around the nourished areas to efficiently achieve the desired initial construction elevation. The berms would be breached following construction to allow dewatering and settlement to the final target marsh elevation. Vegetation plantings would follow protocols and species assemblages used at the reference site.

Following marsh restoration actions, non-native/undesirable species monitoring would be implemented. If species are found, measures would be taken to stop or slow the expansion of the species within the restoration units.

Containment Levee Repair

The existing containment levee would be repaired to a uniform elevation of +5.0 feet MSL and slopes restored to 3:1 (Figure 3) to limit tidal influence and salinity intrusion into interior existing and restored marshes. Sediment for the repair would come from material placed in the marsh restoration areas.

Under the existing condition, numerous breaches in the levee allow saltwater intrusion and high energy flows which scour and cause erosion, increase land loss, and convert marsh habitat to open water.

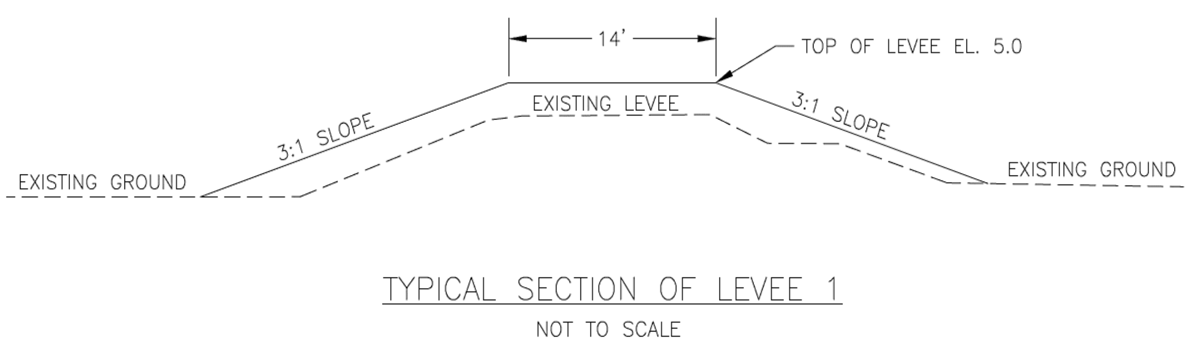

Figure 3. Typical cross-section of the repaired containment levee

Breakwaters

Hickory Cove's shoreline runs parallel to the SNWW/GIWW on the northern side of Sabine Lake and is exposed to wave action that has repeatedly degraded the containment levee on the exterior of the marsh. In addition to navigation traffic subjecting the shoreline to erosive forces, Hickory Cove's shoreline is along the northern boundary of the lake with a significant fetch leaving it vulnerable to wind-driven and ship induced wave action. Attenuating waves through construction of approximately 14,623 linear feet (LF) of breakwaters was considered necessary to mitigate degradation and breach of the containment levee and subsequent marsh degradation exacerbated by these conditions. The preliminary design of this feature is shown in Figure 4.

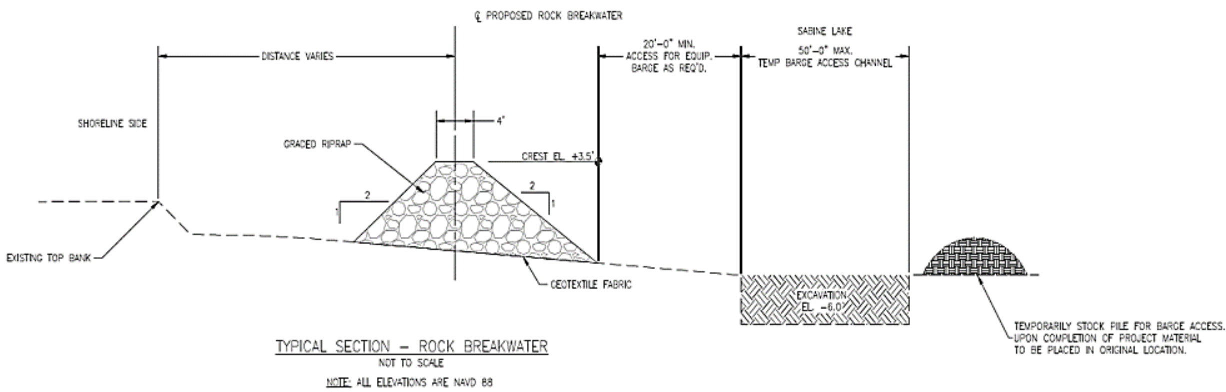

Figure 4. Typical cross-section of the breakwaters

The structures would be built in shallow water (<three feet deep) at varying distances from the shoreline and where soils are conducive to supporting the weight of the stone without significant subsidence. The distance from the shoreline would be determined during PED, after site specific surveys have been completed, but sufficiently offset from the boundaries of the SNWW navigation channel to ensure continued safe navigation.

The design would be a trapezoidal structure built of approximately 138,000 tons of stone up to a height of +3.5 feet MSL, which will yield approximately 1-1.5 feet of rock exposed above the mean high tide level. Other approximate features of the design include a four-foot wide crown, a 2:1 slope, and a base that is roughly 30 feet wide. The structure would have a total footprint of approximately 2 acres. The base of the structure would be on filter cloth ballasted to the water bottom to secure placement and prevent displacement of the outboard edges. The number of openings and width of each would be determined during PED and dependent on the location of major channel entrances or access points required for fishery access or circulation and potential for erosion to affect the existing containment levee.

Living Shoreline

A 95-acre living shoreline would be planted between the existing containment levee and the breakwaters. Invasive plant species, primarily Chinese tallow (*Triadica sebifera*) would be removed from the levee and smooth cordgrass (*Spartina alterniflora*) would be planted along the tow of the levee to form the living shoreline. Approximately 217,000 *S. alterniflora* plugs would be planted with 60-inch spacing. Establishment of this feature would provide toe protection to the existing containment levee and promote sediment accretion to regain lost habitat.

Equipment Needs and Access Routes

Sediment transport equipment would most likely include cutterhead dredges, pipelines (submerged, floating, and land) and one booster pump. Heavy machinery would be used to move sediment and facilitate construction. Heavy equipment could include bulldozers, front-end loaders, track-hoes, marshbuggies, track-hoes, and backhoes. For breakwater construction, stone would be purchased from a commercial quarry and transported to the site by barge, where it would then be placed by crane or hopper barge. Various support equipment would also be used, such as crew and work boats, trucks, trailers, construction trailers, all-terrain vehicles, and floating docks and temporary access channels to facilitate loading and unloading of personnel and equipment.

Identification of staging areas, pipeline routes, and placement of floatation docks would occur during PED. Each disturbance for access and staging would be placed outside of environmentally sensitive areas to the greatest extent practicable and utilize areas already disturbed when possible (e.g. stage on existing agricultural bare ground, existing roadways, or mowed/pastured private lands). All ground disturbance for access and staging areas would be temporary and fully restored to result in no permanent loss.

Timing

Timing of initial construction of this project (Phase 1) is dependent on several factors including: timing of authorization, duration of the PED phase, and Federal- and non-federal funding cycles. It was assumed that construction would begin in March 2024 and have approximately 30 months of on-the-ground work (Table 1). These dates and are based on the next projected SNWW Neches River or Sabine River dredging cycle. The timing of Phase 2 and Phase 3 marsh restoration units are uncertain at this time but would not likely occur before 2027 unless an emergency dredging cycle occurs as a result of excess shoaling from a storm event.

Table 1. Anticipated construction schedule

Measure	Duration	Start	End
Dredging, Phase 1 Marsh Restoration, Containment Levee Repair	12	Mar 2024	Feb 2025
Breakwaters	16	Mar 2025	Jul 2026
Living Shoreline	2	Mar 2027	Apr 2027

CONSISTENCY WITH THE TEXAS COASTAL MANAGEMENT PROGRAM

Transportation to and placement of the dredged material in the restoration units and all associated restoration activities will be analyzed in this document for consistency with the policies of the Texas Coastal Management Program (TCMP). Dredging is not assessed in this document as they have been assessed in the SNWW Channel Improvement Plan (CIP) Final Feasibility Report and Final Environmental Impact Statement (USACE 2011). CIP dredging and placement activities have been identified as consistent with the policies of the TCMP. The proposed activities would not include additional dredging needs greater than described in the CIP.

Impacts on Coastal Natural Resource Areas

Potential impacts to Coastal Natural Resource Areas (CNRAs) listed in 31 Texas Administrative Code (TAC) §501.3, and methods to minimize or avoid potential impacts, are discussed below. Eleven of the 16 CNRAs would not be temporarily or permanently affected (negatively/adversely or beneficially) by project implementation including: Coastal Barriers, Coastal Historic Areas, Coastal Preserves, Coastal Wetlands, Critical Dune Areas, Critical Erosion Areas, Gulf Beaches, Hard Substrate Reefs, Oyster Reefs, Tidal Sand and Mud Flats, and Waters of Gulf of Mexico, due to the lack of the resource, as defined in §501.3, in the project area. The following five CNRAs have the potential to be impacted by implementation of the TSP; however, all impacts would be less than adverse.

Coastal Shore Areas

A coastal shore area is defined as areas within 100 feet landward of the high-water mark on submerged land. Restoration units closest to the SNWW have coastal shore areas found within them. These areas would not be adversely impacted by project implementation because it is anticipated that the form and function of the current coastal system improve through restoration and resiliency of existing and historic marsh in the action area after construction is complete.

Special Hazard Areas

Special hazard areas are areas designated by the Administrator of the Federal Insurance Administration under the National Flood Insurance Act as having special flood, mudslide, and/or flood-related erosion hazards and shown on a Flood Hazard Boundary Map or Flood Insurance Rate Map as Zone A, AO, A1-30, AE, A99, AH, VO, V1-30, VE, V, M, or E. All areas in the action area are designated as within the 100-year coastal floodplain and have a V12 or A8 designation on the Federal Emergency Management Agency Flood Maps for Orange County, Texas (Unincorporated Areas). Implementation of the project may ease the impacts of flooding under relative sea level change (RSLC) but would not induce development of special hazard areas.

Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) is defined as rooted aquatic vegetation growing in permanently inundated areas in estuarine and marine systems. Submerged aquatic vegetation exists within the shallow areas of existing interior marsh areas and is very limited to non-existent in the existing interior open water as observed during field surveys. On the seaward side of the containment levee, no SAV was found during field surveys. A potential for some very minor SAV loss in the open water areas is possible, however, it would be anticipated that a net increase in SAV post-construction would occur due to shallower and less turbid water similar to conditions found in existing interior marsh areas in the action area and at the reference site. Since no SAV was found on the seaward side of the containment levee, placement of stone and planting of vegetation would have no impact.

Submerged Lands

Submerged lands are lands located under waters under tidal influence or under waters of the open Gulf of Mexico, without regard to whether the land is owned by the state or a person other than the state. The Texas General Land Office (GLO) shapefile for "State Submerged Lands" shows the breakwater and dredging sites as submerged lands, while the living shoreline, containment levee, and interior marsh restoration areas are not considered submerged lands. Construction of 14,623 LF of breakwater would be constructed exclusively upon approximately two acres of submerged lands, therefore navigation servitude will be exercised and no acquisition will be required for this aspect of the project. The presence of the breakwater would beneficially modify the tidal flows and erosion rates affecting the shoreline by reducing erosive forces and stabilizing the shoreline. The structures would be close enough to the shoreline to have no adverse effects in any submerged lands seaward of the breakwaters including having no impact on recreational opportunities or navigation safety.

The dredged material used to restore marshes would come from areas in which dredging activities could impact submerged lands. These impacts were analyzed in the SNWW CIP Final Feasibility Report and Final Environmental Impact Assessment and in the Operations and Maintenance plans of the SNWW and were found to be not significant or adverse.

Waters under Tidal Influence

Waters under tidal influence are defined as water in the state that is subject to tidal influence according to the Texas Commission on Environmental Quality (TCEQ) stream segment map, which includes coastal wetlands. The project area is located in a tidally influenced region. Implementation of the project would result in minimal, temporary localized adverse impacts from dredging and placement activities. Temporary impacts include release of suspended solids and turbidity, both which lead to decreased water quality. In the long-term, restoration activities would be beneficial to waters under tidal influence because proposed activities would restore form and function within the restoration unit, which should allow tidal energies to work as nature designed, including reducing subsidence, increasing sediment inputs into the system and creating nursery, foraging, and migrating habitat for a host of freshwater, marine, and terrestrial species, and creating a sustainable and resilient system.

Enforceable Policies

The 20 enforceable policies were reviewed, and it was determined that five policies are applicable to this study (Table 2).

Table 2. CMP Enforceable Policies

Policy	Applicability
§ 501.15 Policy for Major Actions	N/A
§ 501.16 Policies for Construction of Electric Generating and Transmission Facilities	N/A
§ 501.17 Policies for Construction, Operation, and Maintenance of Oil and Gas Exploration and Production Facilities	N/A
§ 501.18 Policies for discharges of Wastewater and Disposal of Waste from Oil and Gas Exploration and Production Activities	N/A
§ 501.19 Policies for Construction and Operation of Solid Waste Treatment, Storage, and Disposal Facilities	N/A
§ 501.20 Policies for Prevention, Response and Remediation of Oil Spills	N/A
§ 501.21 Policies for Discharge of Municipal and Industrial Wastewater to Coastal Waters	N/A
§ 501.22 Policies for Nonpoint Source (NPS) Water Pollution	N/A
§ 501.23 Policies for Development in Critical Areas	**Yes**
§ 501.24 Policies for Construction of Waterfront Facilities and Other Structures on Submerged Lands	**Yes**
§ 501.25 Policies for Dredging and Dredged Material Disposal and Placement	**Yes**
§ 501.26 Policies for Construction in the Beach/Dune System	N/A
§ 501.27 Policies for Development in Coastal Hazard Areas	**Yes**
§ 501.28 Policies for Development Within Coastal Barrier Resource System Units and Otherwise Protected Areas on Coastal Barriers	N/A
§ 501.29 Policies for Development in State Parks, Wildlife Management Areas or Preserves	N/A
§ 501.30 Policies for Alteration of Coastal Historic Areas	N/A
§ 501.31 Policies for Transportation Projects	N/A
§ 501.32 Policies for Emission of Air Pollutants	**Yes**
§ 501.33 Policies for Appropriations of Water	N/A
§ 501.34 Policies for Levee and Flood Control Projects	N/A

§ 501.23 Policies for Development in Critical Areas

(a) Dredging and Construction of structures in, or the discharge of dredged or fill material into, critical areas shall comply with the policies in this section. In implementing this section, cumulative and secondary adverse effects of these activities will be considered.

(1) The policies in this section shall be applied in a manner consistent with the goal of achieving no net loss of critical area functions and values.

Compliance: There is no net loss of critical area functions and values. The purpose of the plan is to restore critical areas and minimize future loss due to RSLC and general area degradation from irreversible cultural modifications (e.g. altered hydrologic regimen) to the coastal system.

(2) Persons proposing development in critical areas shall demonstrate that no practicable alternative with fewer adverse effects is available.

Compliance: During plan formulation, all measures that would have greater impacts than others were screened from further inclusion in any of the formulated plans. The recommended TSP takes advantage of sediment from existing dredging cycles from the SNNW which reduces the need for upland placement or offshore disposal of maintenance dredge materials. As well, there is sufficient material, in quantity and quality, from maintenance dredging that there is no demonstrated need to find an offshore borrow source of material. The identified restoration area was based on the critical need for restoration. Other areas were identified but were determined to not have as great of a need and were therefore screened from incorporation into the plan. With incorporation of beneficial use of dredge material (BUDM) and selection of only the most critical units in need of restoration, there is no practicable alternative with fewer adverse effects that also provides the same level of restoration benefits.

(3) In evaluating practicable alternatives, the following sequence shall be applied:

(A) Adverse effects on critical areas shall be avoided to the greatest extent practicable.

(B) Unavoidable adverse effects shall be minimized to the greatest extent practicable by limiting the degree or magnitude of the activity and its implementation

(C) Appropriate and practicable compensatory mitigation shall be required to the greatest extent practicable for all adverse effects that cannot be avoided or minimized.

Compliance: There are no anticipated adverse effects to critical areas. Implementation of the TSP would result in temporary impacts to critical areas that would not rise to the level of adverse per §501.3. All long-term impacts are beneficial in nature and would result in overall higher quality critical areas due to the restoration nature of the project.

(4) Compensatory mitigation includes restoring adversely affected critical areas or replacing adversely affected critical areas by creating new critical areas. Compensatory mitigation should be undertaken, when practicable, in areas adjacent or contiguous to the affected critical areas (on-site)…

(5) Mitigation banking is acceptable compensatory mitigation if use of the mitigation bank has been approved by the agency authorizing the development and mitigation credits are available for withdrawal…

(6) In determining compensatory mitigation requirements, the impaired functions and values of the affected critical area shall be replaced on a one-to-one ratio…

Compliance: There is no net loss of critical areas therefore no mitigation is needed. All negative impacts are temporary in nature occurring only during the construction periods. Long-term permanent impacts are beneficial resulting in a net increase in function and value of the critical areas.

(7) Development in critical areas shall not be authorized if significant degradation of critical areas will occur. Significant degradation occurs is:

(A) The activity will jeopardize the continued existence of species listed as endangered or threatened, or will result in likelihood of the destruction or adverse modification of a habitat determined to be a critical habitat under the Endangered Species Act, 16 United States Code Annotated, §§1531-1544;

(B) the activity will cause or contribute, after consideration of dilution and dispersion, to violation of any applicable surface water quality standards established under §501.21 of this title;

(C) the activity violates any applicable toxic effluent standard or prohibition established under §501.21 of this title;

(D) the activity violates any requirement improved to protect a marine sanctuary designated under the Marine Protection, Research, and Sanctuaries Act of 1972, 33 United States Code Annotated, Chapter 27; or

(E) taking into account the nature and degree of all identifiable adverse effects, including their persistence, permanence, areal extent, and the degree to which these effects will have been mitigated pursuant to subsections (c) and (d) of this section, the activity will, individually or collectively, cause or contribute to significant adverse effects on:

(i) human health and welfare, including effects on water supplies, plankton, benthos, fish, shellfish, wildlife, and consumption of fish and wildlife;

(ii) the life stages of aquatic life and other wildlife dependent on aquatic ecosystems, including the transfer, concentration, or spread of pollutants or their byproducts beyond the site, or their introduction into an ecosystem, through biological, physical, or chemical processes;

(iii) ecosystem diversity, productivity, and stability, including loss of fish and wildlife habitat or loss of the capacity of a coastal wetland to assimilate nutrients, purify water, or reduce wave energy; or

(iv) generally accepted recreational, aesthetic or economic values of the critical area which are of exceptional character and importance.

Compliance: The project would not cause significant adverse effects on human health and welfare or any of the natural resources or systems listed above. It would not reduce ecosystem diversity, productivity, or the capacity of the wetland systems to assimilate nutrients, purify water, or reduce wave energy. In fact, the project would improve ecosystem diversity and productivity, while increasing the capacity of the wetland systems to function.

(b) The TCEQ and the RRC shall comply with the policies in this section when issuing certifications and adopting rules under Texas Water Code, Chapter 26, and the Texas Natural Resources Code, Chapter 91, governing certification of compliance with surface water quality standards for federal actions and permits authorizing development affecting critical areas; provided that activities exempted from the requirement for a permit for the discharge of dredge or fill material, described in Code of Federal Regulations, Title 33, §323.4 and/or Code of Federal Regulations, Title 40, §232.3, including…shall not be considered activities for which a certification in required. The GLO and the SLB shall comply with the policies in this section when approving oil, gas, or other mineral lease plans of operation or granting surface leases, easements, and permits and adopting rules under the Texas Natural Resources Code, Chapters 32, 33, and 51-53, and Texas Water Code, Chapter 61, governing development affecting critical areas on state submerged lands and private submerged lands, and when issuing approval and adopting rules under Texas Natural Resources Code, Chapter 221, for mitigation banks operated by subdivisions of the state.

Compliance: A 404(b)(1) analysis has been prepared and will be submitted to TCEQ for approval.

(c) Agencies required to comply with this section will coordinate with one another and with federal agencies when evaluating alternatives, determining appropriate and practicable mitigation, and accessing significant degradation. Those agencies' rules governing authorizations for development in critical areas shall require a demonstration that the requirements of subsection (a)(1)-(7) of this section have been satisfied.

Compliance: Coordination has been conducted with U.S. Fish and Wildlife Service, National Marine Fisheries Service, Texas Parks and Wildlife Department, and GLO. Other agencies, such as the Environmental Protection Agency, TCEQ, and Texas Historical Commission have been notified of the project but have not commented.

(d) For any dredging or construction of structures in, or discharge of dredge or fill material into, critical areas that is subject to the requirements of §501.15 of this title (relating to Policy for Major Actions), data and information on the cumulative and secondary adverse affects of the project need not be produced or evaluated to comply with this section if such data and information is produced and evaluated in compliance with §501.15(b)-(c) of this title.

Compliance: The project complies with §501.15(b) – (c).

§501.24 Policies for Construction of Waterfront Facilities and Other Structures on Submerged Lands

(a) Development on submerged lands shall comply with the policies in this section.

(1) Marinas shall be designed and, to the greatest extent practicable, sited so that tides and currents will aid in flushing of the site or renew its water regularly.

(2) Marinas designed for anchorage of private vessels shall provide facilities for the collection of waste, refuse, trash, and debris.

(3) Marinas with the capacity for long-term anchorage of more than ten vessels shall provide pump-out facilities for marine toilets, or other such measures or facilities that provide an equal or better level of water quality protection.

Compliance: The project does not involve construction of a marina.

(4) Marinas, docks, piers, wharves and other structures shall be designed and, to the greatest extent practicable, sited to avoid and otherwise minimize adverse effects on critical areas from boat traffic to and from those structures.

Compliance: The breakwater structure would not be placed in any critical areas and would not modify the current navigational routes; therefore, the project will not have any direct or indirect effect on critical areas.

(5) Construction of docks, piers, wharves, and other structures shall be preferred instead of authorizing dredging of channels or basins or filling of submerged lands to provide access to coastal waters if such construction is practicable, environmentally preferable, and will not interfere with commercial navigation.

Compliance: The breakwater structure is not intended to provide access to coastal waters and would protect the existing shoreline from commercial navigation along the SNWW. It is possible that stabilization of the shoreline (breakwaters and living shoreline) would reduce the need for dredging through this section of the SNWW by trapping sediments and preventing them from shoaling in the Federal channel.

(6) Piers, docks, wharves, bulkheads, jetties, groins, fishing cabins, and artificial reefs (including artificial reefs for compensatory mitigation) shall be limited to the minimum necessary to serve the project purpose and shall be constructed in a manner that:

(A) does not significantly interfere with public navigation;

Compliance: The alignment of the breakwaters would be sufficiently offset from the SNWW to not interfere with public navigation or create hazardous navigational conditions.

(B) does not significantly interfere with the natural coastal processes which supply sediments to shore areas or otherwise exacerbate erosion of shore areas; and

Compliance: The breakwaters would attenuate wave and tidal energies along the shoreline and minimize the movement of sediments into and out of the area. However, this modification is considered beneficial since the current high rates of erosion would be mitigated and the shoreline stabilized thereby protecting existing shoreline (marsh) resources. Additionally, breakwaters and the living shoreline have been shown to trap sediments allowing for an accretion of land and area for marsh establishment.

(C) avoids and otherwise minimizes shading of critical areas and other adverse effects

Compliance: The alignment of the breakwater avoids all critical areas and would not induce adverse effects.

(7) Facilities shall be located at sites or designed and constructed to the greatest extent practicable to avoid and otherwise minimize the potential for adverse effects from:

(A) construction and maintenance of other development associated with the facility;

(B) direct release to coastal waters and critical areas of pollutants from oil or hazardous substance spills or stormwater runoff; and

(C) deposition of airborne pollutants in coastal waters and critical areas.

Compliance: The project does not involve construction of any facilities that would induce development or modify existing development operations, nor would the structure produce or emit hazardous substances or emissions.

(8) Where practicable, pipelines, transmission lines, cables, roads, causeways, and bridges shall be located in existing rights-of-way or previously disturbed areas if necessary to avoid or minimize adverse effects and if it does not result in unreasonable risks to human health, safety, and welfare.

Compliance: The project does not involve construction or long-term operation of pipelines, transmission lines, cables, roads, causeways, or bridges.

(9) To the greatest extent practicable, construction of facilities shall occur at sites and times selected to have the least adverse effects on recreational uses of CNRAs and on spawning or nesting seasons or seasonal migrations of terrestrial and aquatic wildlife.

Compliance: Construction of the breakwater would span approximately 16 months which would overlap with spawning and nesting seasons of terrestrial and aquatic wildlife. However, the disturbance area would be limited to the immediate construction site in open water areas and should not affect aquatic migration or spawning outside of the active construction site and would have no effect on nesting or migration patterns of terrestrial species. Openings in the breakwater would be placed in the structure so long-term migration and spawning would be unaffected. The alignment of the breakwater would be in close proximity to the shoreline and is not expected to affect recreation in or near CNRAs outside of the alignment.

(10) Facilities shall be located at sites which avoid the impoundment and draining of coastal wetlands. If impoundment or draining cannot be avoided, adverse effects to the impounded or drained wetlands shall be mitigated in accordance with the sequencing requirements of §501.23 of this title. To the greatest extent practicable, facilities shall be located at sites at which expansion will not result in development in critical areas.

Compliance: Coastal wetlands, as defined in §501.3, are not found in or near the project area. Coastal marshes would not be directly affected by construction and long-term operation of the breakwater; however, over the long-term, the breakwaters would protect and stabilize the shoreline thereby also protecting marsh habitats and potentially increasing their area through accretion of sediments and reduction in saltwater intrusion.

> *(11) Where practicable, piers, docks, wharves, bulkheads, jetties, groins, fishing cabins, and artificial reefs shall be constructed with materials that will not cause any adverse effects on coastal waters or critical areas.*

Compliance: The breakwaters would be constructed of stone free of any chemicals or sealants that could cause adverse effects on coastal waters or critical areas.

> *(12) Developed sites shall be returned as closely as practicable to pre-project conditions upon completion or cessation of operations by the removal of facilities and restoration of any significantly degraded areas, unless:*
>
> > *(A) the facilities can be used for public purposes or contribute to the maintenance or enhancement of coastal water quality, critical areas, beaches, submerged lands, or shore areas; or*
> >
> > *(B) restoration activities would further degrade CNRAs.*

Compliance: The breakwater structure would not be removed, and the area would not be returned to pre-project conditions at the end of the project life (estimated 50 years). The breakwaters are expected to have long-term beneficial impacts that if the breakwaters were removed would contribute to degradation of the shoreline and marsh areas. As well removal of the structure would result in the loss of hard substrate habitat that will have provided habitat for colonized by small fish, crustaceans, and mollusks, provide a food source for wildlife such as raccoons, skunks, reptiles, and small mammals, and loafing and roosting habitat for avian species.

> *(13) Water-dependent uses and facilities shall receive preference over those uses and facilities that are not water-dependent.*

Compliance: The breakwater would promote the protect and stabilization of the shoreline and marsh habitats which contributes to recreational opportunities in the project area.

> *(14) Nonstructural erosion response methods such as beach nourishment, sediment bypassing, nearshore sediment berms, and planting of vegetation shall be preferred instead of structural erosion response methods.*

Compliance: A living shoreline (planting of native marsh vegetation) has been incorporated into the plan as a secondary method of shoreline stabilization and toe protection of the existing containment levee. Construction of a living shoreline alone would not be sufficient to reduce the ship-wake induced energies contributing to current shoreline erosion; therefore, over the long-term construction of a structural erosion response feature – a breakwater – is warranted and in the best interest of the coastal resources in the action area.

(15) Major residential and recreational waterfront facilities shall to the greatest extent practicable accommodate public access to coastal waters and preserve the public's ability to enjoy the natural aesthetic values of coastal submerged lands.

(16) Activities on submerged land shall avoid and otherwise minimize any significant interference with the public's use of and access to such lands.

Compliance: Construction of the breakwaters would not interfere with public access to or use of coastal waters and preserves. Opening in the structure would provide access to open water areas of the landward side of the structure.

(17) Erosion of Gulf beaches and coastal shore areas caused by construction or modification of jetties, breakwaters, groins, or shore stabilization projects shall be mitigated to the extent the costs of mitigation are reasonably proportionate to the benefits of mitigation. Factors that shall be considered in determining whether the costs of mitigation are reasonably proportionate to the cost of the construction or modification and benefits include, but are not limited to, environmental benefits, recreational benefits, flood or storm protection benefits, erosion prevention benefits, and economic development benefits.

Compliance: The project would not modify any existing shoreline protection measures and construction of the feature would reduce erosion along the coastal shore area; therefore, no mitigation is needed. It is anticipated that long-term operation of the breakwater would result in shoreline stabilization and increase in marsh habitat between the landward side of the breakwater and the existing containment levee and provide resiliency to interior marshes from sea level rise through protection of the existing containment levee and a reduction in saltwater intrusion.

(b) To the extent applicable to the public beach, the policies in this section are supplemental to any further restrictions or requirements relating to the beach access and use rights of the public.

Compliance: No beaches are present or would be affected by construction of the breakwater.

(c) The GLO and the SLB, in governing development on state submerged lands, shall comply with the policies in this section when approving oil, gas, and other mineral lease plans of operation and granting surface leases, easements, and permits and adopting rules under the Texas Natural Resources Code, Chapters 32, 33 and 51 - 53, and Texas Water Code, Chapter 61.

Compliance: The project does not involve development of oil, gas, or other mineral lease plans of operation or granting of surface leases, easements, or permits or adopting rules.

§501.25 Policies for Dredging and Dredged Material and Placement

(a) Dredging and the disposal and placement of dredge material shall avoid and otherwise minimize adverse effects to coastal waters, submerged land, critical areas, coastal shore areas, and Gulf beaches to the greatest extent practicable. The policies of this section are supplement to any further restrictions or requirements relating to the beach access and use rights of the public. In implementing this section, cumulative and secondary adverse effects of dredging and the disposal and the placement of dredge material and the unique characteristics of affected sites shall be considered.

Compliance: Dredged material would be beneficially used to restore emergent marshes. Placement in each of the restoration units would have some effects on tidally influenced areas and coastal shore areas. Effects include but are not limited to burying benthic organisms, temporary increase in turbidity in the area, and temporary restrictions to specific areas. Restoration activities would result in a net increase in CNRAs and overall quality of existing CNRAs (see Appendix B-6 of the Integrated Feasibility Report and Environmental Assessment).

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

Compliance: Placement of dredge material would not violate any applicable surface water quality standards.

(2) *Except as otherwise provided in paragraph (4) of this subsection, adverse effects on critical areas from dredging and dredged material disposal or placement shall be avoided and otherwise minimized, and appropriate and practicable compensatory mitigation shall be required, in accordance with §501.23 of this title.*

Compliance: Project implementation would not result in any long-term, permanent, or irreversible adverse effects on CNRAs and would realize a net increase in some critical areas (e.g. SAV habitat); therefore, no compensatory mitigation is needed. Placement of beneficial use of dredge material into critical areas would restore function to the affected CNRAs and improve the overall system.

(3) *Except as provided in paragraph (4) of this subsection, dredging and the disposal and placement of dredged material shall not be authorized if:*

   (A) *there is a practicable alternative that would have fewer adverse effects on coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches, so long as that alternative does not have other significant adverse effects;*

   (B) *all appropriate and practicable steps have not been taken to minimize adverse effects on coastal waters submerged lands, critical areas, coastal shore areas, and Gulf beaches; or*

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

Compliance: Critical and coastal shore areas would be temporarily affected by the project during construction, but not result in a long-term net loss of any of the resources that make up these areas. The project has net environmental benefits that would result from restoration activities and project actions would result in restored form and function of critical and coastal shore areas. Construction activities have been minimized to the greatest extent practicable, including reducing overall construction footprint to only what is absolutely necessary and seasonal timing restrictions to avoid breeding/spawning and migrating fish and wildlife impacts to the greatest extent practicable.

(4) *A dredging or dredged material disposal or placement project that would be prohibited solely by application of paragraph (3) of this subsection may be allowed if it is determined to be of overriding importance to the public and national interest in light of economic impacts on navigation and maintenance of commercially navigable waterways.*

Compliance: Placement is not precluded by paragraph (3), as noted above.

(b) *Adverse effects from dredging and dredged material disposal and placement shall be minimized as required in subsection (a) of this section. Adverse effects can be minimized by employing the techniques in this subsection where appropriate and practicable.*

(5) *Adverse effects from dredging and dredge material disposal and placement can be minimized by controlling the location and dimensions of the activity. Some of the ways to accomplish this include:*

Compliance: Placement of material into the restoration unit does not induce adverse effects. Temporary impacts associated with placement have been minimized to the greatest extent possible. See compliance discussions found in section (a) above.

(A) *locating and confining discharges to minimize smothering of organisms;*

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

(C) *using existing or natural channels and basins instead of dredging new channels or basins, and discharging materials in areas that have been previously disturbed or used for disposal or placement of dredged material;*

(D) *limiting the dimensions of channels, basins, and disposal and placement sites to the minimum reasonably required to serve the project purpose, including allowing for reasonable overdredging of channels and basins, and taking into account the need for capacity to accommodate future expansion without causing additional adverse effects;*

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

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

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

Compliance: Open water impacts are minimized by placing dredge material in marshes. All dredged material requirements to implement the project can be provided through existing maintenance dredging cycles, so no modifications to the channel (e.g. widening or deepening, or more frequent dredging) are required to ensure sufficient quantity of sediment to implement. The project's restoration features were designed to improve ecological functions of CNRAs, including proper drainage and suitable substrate material for species composition, and increase resiliency and sustainability to future conditions.

Discharges would be confined with temporary containment/exclusion dikes where applicable to minimize discharge into adjacent areas. The containment dikes would be breached after dewatering and not result in any long-term impoundment or drainage changes to critical areas.

(6) *Dredging and disposal and placement of material to be dredged shall comply with applicable standards for sediment toxicity. Adverse effects from constituents contained in materials discharged can be minimized by treatment of or limitations on the material itself. Some ways to accomplish this include;*

(A) *disposal or placement of dredged material in a manner that maintains physiochemical conditions at discharge sites and limits or reduces the potency and availability of pollutants;*

(B) *limiting the solid, liquid, and gaseous components of material discharged;*

(C) *adding treatment substances to the discharged material; and*

(D) *adding chemical flocculants to enhance the deposition of suspended particulates in confined disposal areas.*

Compliance: Sediments dredged from the SNWW have been tested for a variety of chemical parameters of concern. Samples yielded no cause for concern and sediments are safe for beneficial use.

(7) *Adverse effects from dredging and dredged material disposal or placement can be minimized through control of the materials discharged. Some ways of accomplishing this include:*

(A) *use of containment levees and sediment basins designed, constructed, and maintained to resists breaches, erosion, slumping, or leaching;*

(B) *use of lined containment areas to reduce leaching where leaching of chemical constituents from the material is expected to be a problem;*

(C) *capping in-place contaminated material or, selectively discharging the most contaminated material first and then capping it with the remaining material;*

(D) *properly containing discharged material and maintaining discharge sites to prevent point and nonpoint pollution; and*

(E) *timing the discharge to minimize adverse effects from unusually high water flows, wind, wave, and tidal actions.*

Compliance: Small, temporary containment/exclusion dikes may be created during marsh restoration efforts to limit movement of sediments outside the placement site. After all ground disturbing activities are complete and the site has sufficiently dewatered and settled, the dike would be mechanically breached if sufficient natural degradation has not occurred. Marsh nourishment measures may have some temporary and local impacts by increasing turbidity; however, material to be generated from construction activities has been tested and found not to contain harmful concentrations of pollutants. Discharges would not occur during conditions involving high water flows, waves, or tidal actions.

(8) *Adverse effects from dredging and dredged material disposal or placement can be minimized by controlling the manner in which material is dispersed. Some ways of accomplishing this include:*

(A) *where environmentally desirable, distributing the material in a thin layer;*

(B) *orienting material to minimize undesirable obstruction of the water current or circulation patterns;*

(C) *using silt screens or other appropriate methods to confine suspended particulates or turbidity to a small area where settling or removal can occur;*

(D) *using currents and circulation patterns to mix, disperse, dilute, or otherwise control the discharge;*

(E) *minimizing turbidity by using a diffuser system or releasing material near the bottom;*

(F) *selecting sites or managing discharges to confine and minimize the release of suspended particulates and turbidity and maintain light penetration for organisms; and*

(G) *setting limits on the amount of material to be discharged per unit of time or volume of receiving waters.*

Compliance: All of the sites minimize or avoid adverse dispersal effects to the greatest extent practicable during construction. Material to be used for restoration would be hydraulically discharged at specific discharge points in low elevation and open water areas. As needed, material would be mechanically moved into place with heavy equipment, which should reduce dispersal of material into undesirable areas. Additionally, temporary containment/exclusion dikes would be constructed around marsh restoration units to limit movement of sediments outside of the intended placement area. After all ground disturbing activities are complete and the site has sufficiently dewatered and settled, the dike would be mechanically breached if sufficient natural degradation has not occurred. There are no sediments of concern.

(9) *Adverse effects from dredging and dredged material disposal or placement operations can be minimized by adapting technology to the needs of each site. Some ways of accomplishing this include:*

(A) *using appropriate equipment, machinery, and operating techniques for access to sites and transport of material, including those designed to reduce damage to critical areas;*

(B) *having personnel on site adequately trained in the avoidance and minimization techniques and requirements; and*

(C) *designing temporary and permanent access roads and channel spanning structures using culverts, open channels, and diversions that will pass both low and high water flows, accommodate fluctuating water levels, and maintain circulation and faunal movement.*

Compliance: Dredged material placement into the restoration areas would minimize impacts to the greatest extent practicable including, but not limited to siting pumps and pipes outside of environmentally sensitive and critical areas where possible; utilizing existing access roads and channels to move material, equipment and personnel; and employing Best Management Practices (BMPs) to avoid adverse impacts. During PED, ways to further reduce environmental impacts to all areas and resources will be considered and employed to the greatest extent practicable.

(10) Adverse effects on plant and animal populations from dredging and dredged material disposal or placement can be minimized by:

(A) avoiding changes in water current and circulation patterns that would interfere with the movement of animals;

(B) selecting sites or managing discharges to prevent or avoid creating habitat conducive to the development of undesirable predators or species that have a competitive edge ecologically over indigenous plants or animals;

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

(D) using planning and construction practices to institute habitat development and restoration to produce a new or modified environmental state of higher ecological value by displacement of some or all of the existing environmental characteristics;

(E) using techniques that have been demonstrated to be effective in the circumstances similar to those under consideration whenever possible and, when proposed development and restoration techniques have not yet advanced to the pilot demonstration stage, initiating their use on a small scale to allow corrective action if unanticipated adverse effects occur;

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

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

Compliance: The project would be designed and implemented in such a way to avoid adverse impacts to plant and animal populations and their habitat to the greatest extent practicable including, but not limited to seasonal timing restrictions, using existing access roads and channels, employing construction BMPs, siting pumps and pipes in areas that would have the least disturbance on the overall system, and utilizing the smallest construction footprint possible. The project is intended to restore the natural form and function of the coastal system; therefore, all long-term impacts are expected to be beneficial to the overall ecosystem by increasing suitable habitat and increasing resiliency and sustainability.

(11) Adverse effects on human use potential from dredging and dredged material disposal or placement can be minimized by:

(A) selecting sites and following procedures to prevent or minimize any potential damage to the aesthetically pleasing features of the site, particularly with respect to water quality;

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

(C) timing dredging and dredged material disposal or placement activities to avoid the seasons or periods when human recreational activity associated with the site is most important; and

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

Compliance: Placement of dredged material into restoration sites may adversely impact the human environment in and around the placement sites by visually disturbing the scenic view with construction equipment and activity, increasing noise, and reducing the amount of recreational opportunities. All of these impacts would be temporary, only lasting as long as it takes for the material to be appropriately placed and for the restoration area to stabilize. Timing of construction is entirely dependent on dredging cycles; however, during PED it would be advised to avoid the peak recreational seasons (fall/winter) if possible. After construction is complete and vegetation has grown within the restoration sites, recreation and scenic value is expected to increase through increased recreational areas and opportunities (i.e. more wetlands=more hunting).

(12) Adverse effects from new channels and basins can be minimized by locating them at sites:

(A) that ensure adequate flushing and avoid stagnant pockets; or

(B) that will create the fewest practicable adverse effects on CNRAs from additional infrastructure such as roads, bridges, causeways, piers, docks, wharves, transmission line crossing, and ancillary channels reasonably likely to be constructed as a result of the project; or

(C) with the least practicable risk that increased vessel traffic could result in navigation hazards, spills or other forms of contamination which could adversely affect CNRAs;

(D) provided that, for any dredging of new channels or basins subject to the requirements of §501.15 of this title (relating to Policy for Major Actions), data and information on minimization of secondary adverse effects need not be produced or evaluated to comply with this paragraph if such data and information is produced and evaluated in compliance with §501.15(b)(1) of this title.

Compliance: The project does not include constructing new channels or basins, therefore §501.25(8)(A)-D) does not apply.

(c) Disposal or placement of dredged material in existing contained dredge disposal sites identified and actively used as described in an environmental assessment or environmental impact statement issued prior to the effective date of this chapter shall be presumed to comply with the requirements of subsection (a) of this section unless modified in design, sign, use, or function.

(d) Dredged material from dredging projects in commercially navigable waters is a potentially reusable resource and must be used beneficially in accordance with this policy.

(1) If the costs of beneficial use of dredged material area reasonably comparable to the costs of disposal in a non-beneficial manner, the material shall be used beneficially.

(2) If the costs of the beneficial use of dredged material are significantly greater than the costs of disposal in a non-beneficial manner, the material shall be used beneficially unless it is demonstrated that the costs of using the material beneficially are not reasonably proportionate to the costs of the project and benefits that will result. Factors that shall be considered in determining whether the costs of the beneficial use are not reasonably proportionate to the benefits include but are not limited to:

(A) environmental benefits, recreational benefits, floor or storm protection benefits, erosion prevention benefits, and economic development benefits;

(B) the proximity of the beneficial use site to the dredge site; and

(C) the quantity and quality of the dredged material and its suitability for beneficial use.

(3) Examples of the beneficial use of dredged material include, but are not limited to:

(A) projects designed to reduce or minimize erosion or provide shoreline protection;

(B) projects designed to create or enhance public beaches or recreational areas;

(C) projects designed to benefit the sediment budget or littoral system;

(D) projects designed to improve or maintain terrestrial or aquatic wildlife habitat;

(E) projects designed to create new terrestrial or aquatic wildlife habitat, including the construction of marshlands, coastal wetlands, or other critical areas;

(F) projects designed and demonstrated to benefit benthic communities or aquatic vegetation;

(G) projects designed to create wildlife management areas, parks, airports, or other public facilities;

(H) projects designed to cap landfills or other water disposal areas;

(I) projects designed to fill private property or upgrade agricultural land, if cost-effective public beneficial uses are not available; and

(J) projects designed to remediate past adverse impacts on the coastal zone.

(e) If dredged material cannot be used beneficially as provided in subsection (d)(2) of this section, to avoid and otherwise minimize adverse effects as required in subsection (a) of this section, preference will be given to the greatest extent practicable to disposal in…

Compliance: Dredged material would be beneficially used to restore marsh habitat throughout the project area; therefore, the project is consistent with §501.25(d)(1) –(3) and §501.25(c) and §501.25(e)(1) –(3) do not apply to this project.

(f) For new sites, dredged materials shall not be disposed of or placed directly on the boundaries of submerged lands or at such location so as to slump or migrate across the boundaries of submerged lands in the absence of an agreement between the affected public owner and the adjoining private owner or owners that defined the location of the boundary or boundaries affected by the deposition of the dredged material.

Compliance: Placement of dredged materials would not be placed directly on submerged lands. If during PED, it is identified that placement would occur on submerged lands, appropriate real estate agreements would be drafted and in place prior to construction to ensure all landowners are appropriately notified and compensated for any loss or impacts.

(g) Emergency dredging shall be allowed without a prior consistency determination as required in the applicable consistency rule when…

Compliance: An emergency situation does not exist with implementation of the project. Consistency of the project with program policy would be determined prior to project authorization.

(h) Mining of sand, shell, marl, gravel, and mudshell on submerged lands shall be prohibited unless there is an affirmative showing of no significant impact on erosion within the coastal zone and no significant adverse effect of coastal water quality or terrestrial and aquatic wildlife habitat within a CNRA.

Compliance: Project activities do not involve mining for shell, marl, gravel or mudshell; however, sand would be dredged from submerged lands of the SNWW for use in restoration units. Dredging sand from this location has already been addressed in other documents.

(i) The GLO and the SLB shall comply with the policies in this section when approving oil, gas, and other mineral lease plans of operation and granting surface leases, easements, and permits and adopting rules under the Texas Natural Resources Code, Chapter 32, 33, and 51 – 53, and Texas Water Code, Chapter 61, for dredging and dredge material disposal and placement TxDOT shall comply with the policies in this subchapter when adopting rules and taking actions as local sponsor of the Gulf Intracoastal Waterway under Texas Transportation Code, Chapter 51. The TCEQ and the RRC shall comply with the policies in this section when issuing certifications and adopting rules under Texas Water Code, Chapter 26, and the Texas Natural Resources Code, Chapter 91, governing certification of compliance with surface water quality standards for federal actions and permits authorizing dredging or the discharge or placement of dredged material. The TPWD shall comply with the policies in this section when adopting rules at Chapter 57 of this title (relating to Fisheries) governing dredging and dredged material disposal and placement. TPWD shall comply with the policies in subsection (h) of this section when adopting

rules and issuing permits under Texas Parks and Wildlife Code, Chapter 86, governing the mining of sand, shell, marl, gravel, and mudshell.

Compliance: This project does not involve oil, gas, and other mineral lease plans of operation or granting of surface leases, easements, or permits; therefore, §501.25(i) does not apply.

§501.32 Policies for Emission of Air Pollutants

TCEQ rules under Texas Health and Safety Code, Chapter 382, governing emissions of air pollutants, shall comply with regulations at Code of Federal Regulations, Title 40, adopted pursuant to the Clean Air Act, 42 United States Code Annotated, §§7401, et seq, to protect and enhance air quality in the coastal area so as to protect CNRAs and promote the public health, safety, and welfare.

Compliance: The project is fully compliant with the Clean Air Act as documented in the DIFR-EA.

CONCLUSION

The project complies with the Texas Coastal Management Program and will be conducted in a manner consistent with all rules and regulations of the program.

US Army Corps of Engineers ®
Galveston District

Appendix B-5

National Historic Preservation Act Compliance

for

WRDA Section 1122 Beneficial Use Pilot Project, Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas

November 2021

Programmatic Agreement

Programmatic Agreement will be placed here when available.

Tribal and State Coordination for Cultural Resources

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

September 27, 2021

Subject: Hickory Cove Marsh Restoration and Living Shoreline Project Coordination

Mr. Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
P.O. Box 12276
Austin, TX 78711-2276

Dear Mr. Wolfe:

The U.S. Army Corps of Engineers (USACE), in partnership with the Orange County Navigation and Port District (non-federal sponsor for the project), is preparing a draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) for the Hickory Cove Marsh Restoration and Living Shoreline Project in Orange County, Texas, UTM 15N 421893E 3318528N. The study was authorized by Section 1122 of the Water Resources Development Act of 2016 which requires the USACE to establish a pilot program to carry out projects for the beneficial use of dredged material. The Hickory Cove Marsh Restoration and Living Shoreline Project was selected by the Office of the Assistant Secretary of the Army for Civil Works to be one of the pilot projects. This project includes the beneficial use of dredged maintenance material from the Sabine-Neches Waterway to restore approximately 650 acres of marsh within an existing 1200-acre impoundment and native plantings along 95 acres of adjacent coastline to create a living shoreline feature. The project also includes repairs to the existing containment levee and the installation of a rock breakwater adjacent to the shoreline to combat wave erosion (see enclosed maps). The marsh restoration is expected to require several dredge cycles to complete. The first dredge cycle is anticipated to begin in 2023 and will discharge 1.3 million cubic yards of maintenance dredged material to restore approximately 190 acres of marsh habitat.

Currently, the shoreline in the project area has eroded due to wave action and navigation traffic. Much of the shoreline has experienced significant loss, to the point that the containment levee surrounding the marsh has been breached. This has allowed estuary water to enter the marshes, where sediments are continually eroding and has converted approximately 80 percent of the project area to open water.

The study area was examined for any known historic properties using the Texas Historical Commission's (Atlas) database. This review found nine previous terrestrial cultural resource surveys and five maritime cultural resources surveys within the focused study area. The area for the proposed living shoreline has been surveyed in its

entirety; however, the areas proposed for the breakwater and the interior portions of the existing impoundment have not been previously surveyed.

Twenty-two previously recorded sites have been identified in the focused study area. Sixteen of those sites are within the living shoreline area that will be directly impacted by the project. Sites within the living shoreline area include: 41OR17, 41RO18, 41OR19, 41OR20, 41OR21, 41OR29, 41OR30, 41OR31, 41OR32, 41OR33, 41OR43, 41OR44, 41OR45, 41OR46, 41OR47, and 41OR48. Sites within the focused study area that will not be directly impacted include: 41OR41, 41OR75, 41OR79, 41JF18, 41JF19, and 41JF20. All locations within the focused study area are shell middens that have not been evaluated for the National Register of Historic Places (NRHP). Twenty sites were recorded in 1940 as many were being mined for the shell. Site 41OR33 was recorded in 1956 as it was actively being destroyed for shell mining. Site 41OR79 was recorded in 1973, and it was noted that a large portion of the site had been removed during dredging activities.

Five additional sites, including 41OR36, an unevaluated shell midden; 41OR73 an ineligible surface shell scatter; 41OR74, an unevaluated destroyed shell midden; 41OR77, an unevaluated shell midden; and 41JF17, an unevaluated shell midden, are located within 1-kilometer of the focused study area. No historic properties or districts listed on the NRHP or cemeteries are present within the focused study area or within 1-kilometer of the concentrated study area. Two Texas historical markers for the Rainbow Bridge (11509 and 10555, respectively) are located within 1-kilometer of the focused study area. The levee surrounding the marsh is less than 50 years old and is not eligible for consideration for the NRHP.

In 1973, the Texas Archaeological Survey conducted a cultural resources survey investigation which included the current project area and was conducted prior to the planned USACE placement of dredged material from the Sabine Neches Waterway. Access to the current project area for the survey was limited due to safety hazards from the high-water table, shallow standing water, and thick vegetation. The survey was limited to shorelines accessible by boat and aerial investigation by helicopter (see attached report). During the 1973 survey, none of the sites recorded between 1940 and 1956 could be accurately relocated and were instead lumped together into three locales. The three locales were described as either destroyed or extremely degraded. Destruction of the sites was mainly attributed to shell mining and continued erosion. Since the 1973 survey, dredged material was placed over the majority of the current project area, including where the remnants of all 16 shoreline sites were located.

Continuing shoreline erosion, subsidence, relative sea level change, and previous disturbances have caused the project area to degrade to the current state which is

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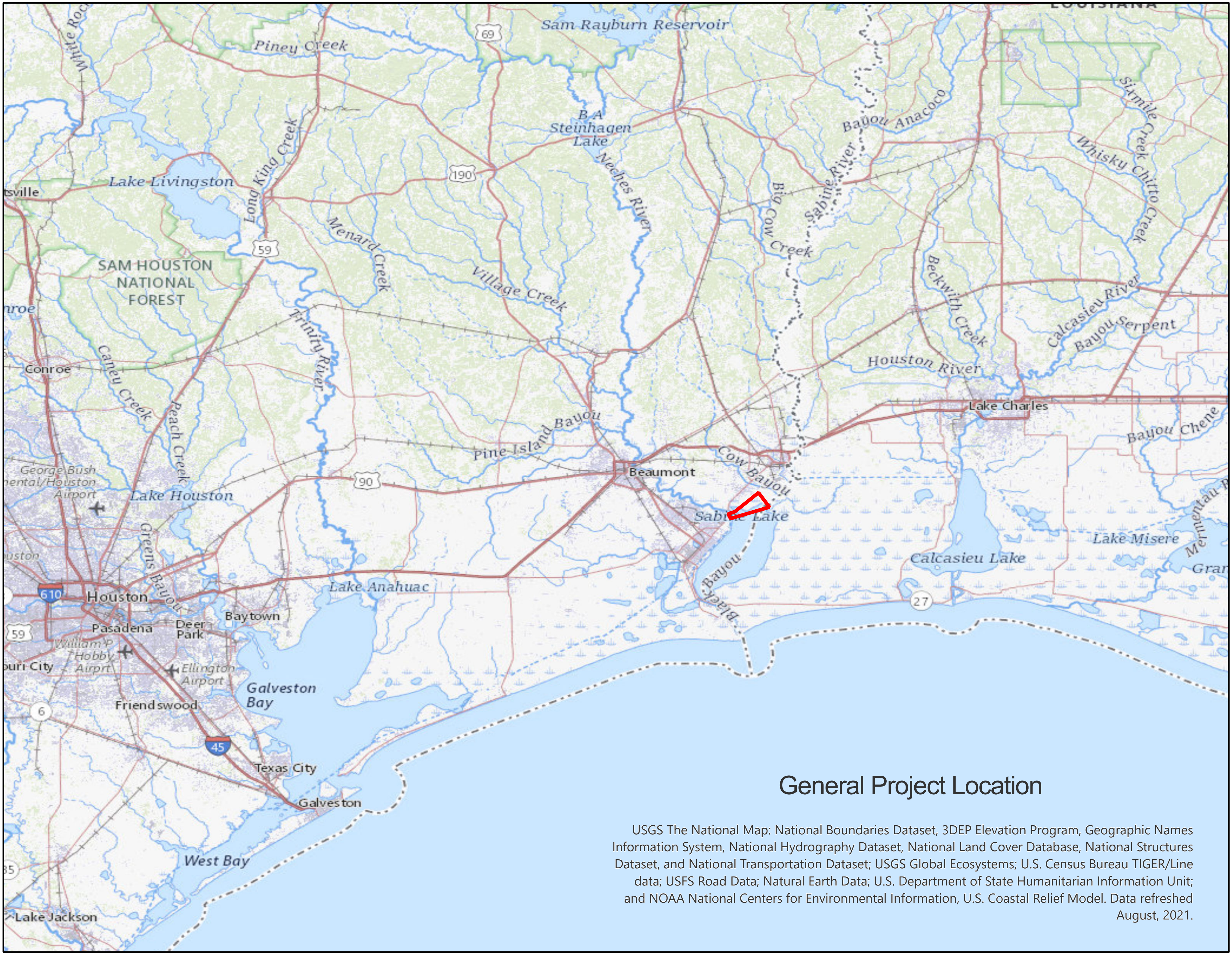
Thank you for your cooperation in this review process. If you have any questions concerning this project or need further assistance, please contact Jackie Rodgers, Archaeologist, Regional Environmental Planning Center at (918) 669-4964 or via email at Jacqueline.Rodgers@usace.army.mil. Your comments would be appreciated within 30 days of receipt of this letter.

Sincerely,

Amanda McGuire

Amanda M. McGuire
Chief, Environmental Branch
Regional Planning and Environmental
Center

Enclosures



General Project Location

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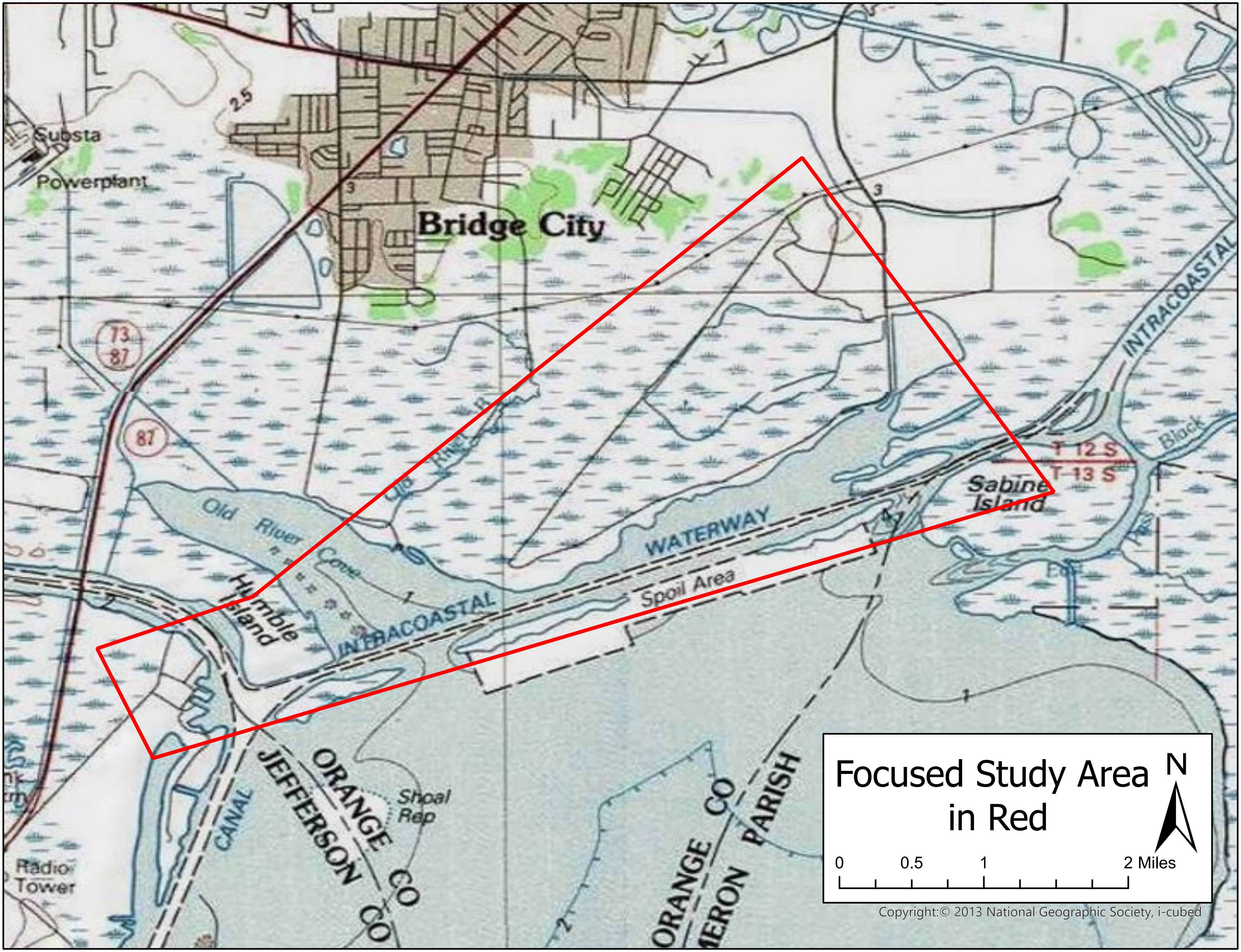
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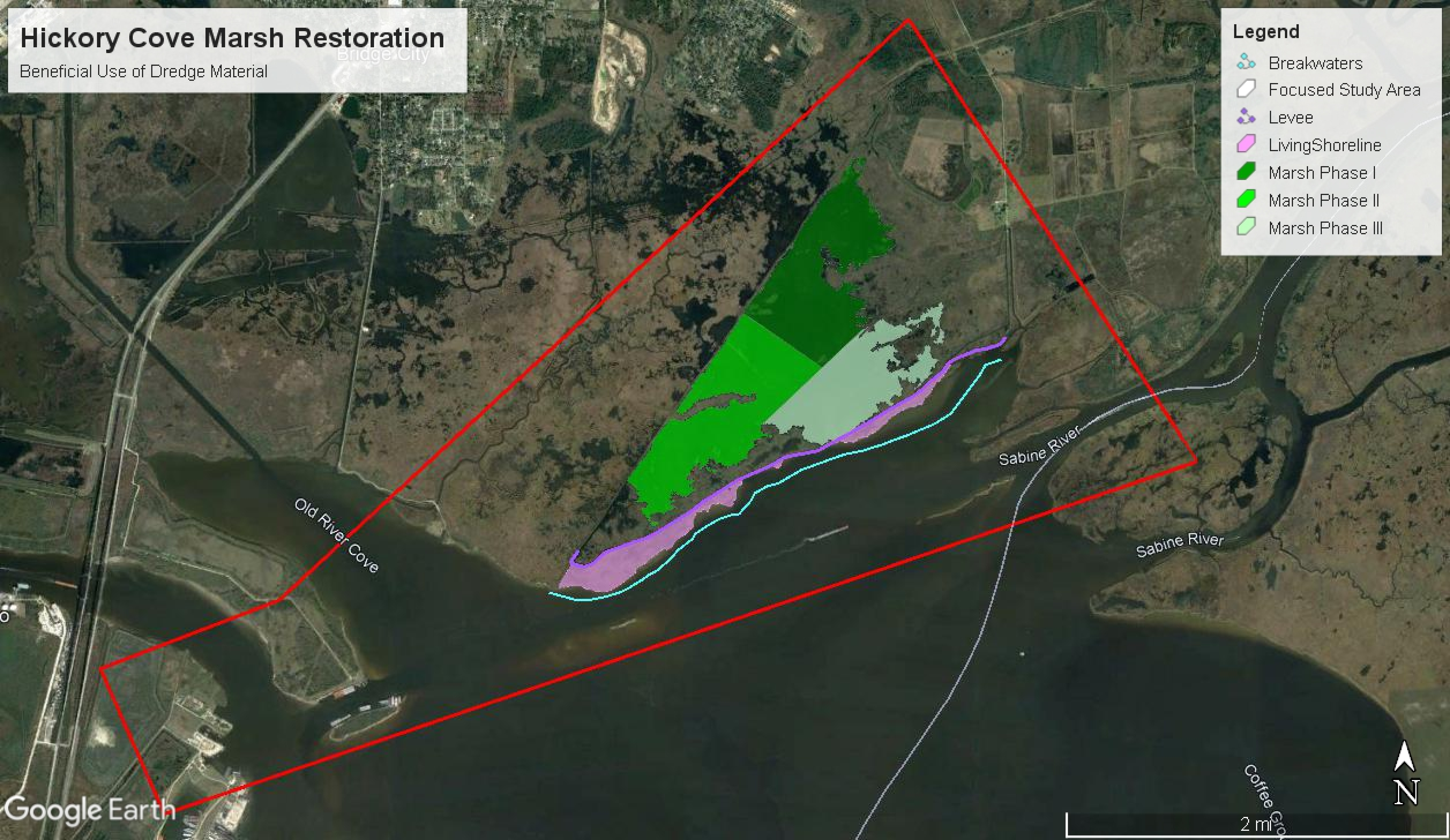

Hickory Cove Marsh Restoration
Beneficial Use of Dredge Material
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Breakwaters
Focused Study Area
Levee
LivingShoreline
Marsh Phase I
Marsh Phase II
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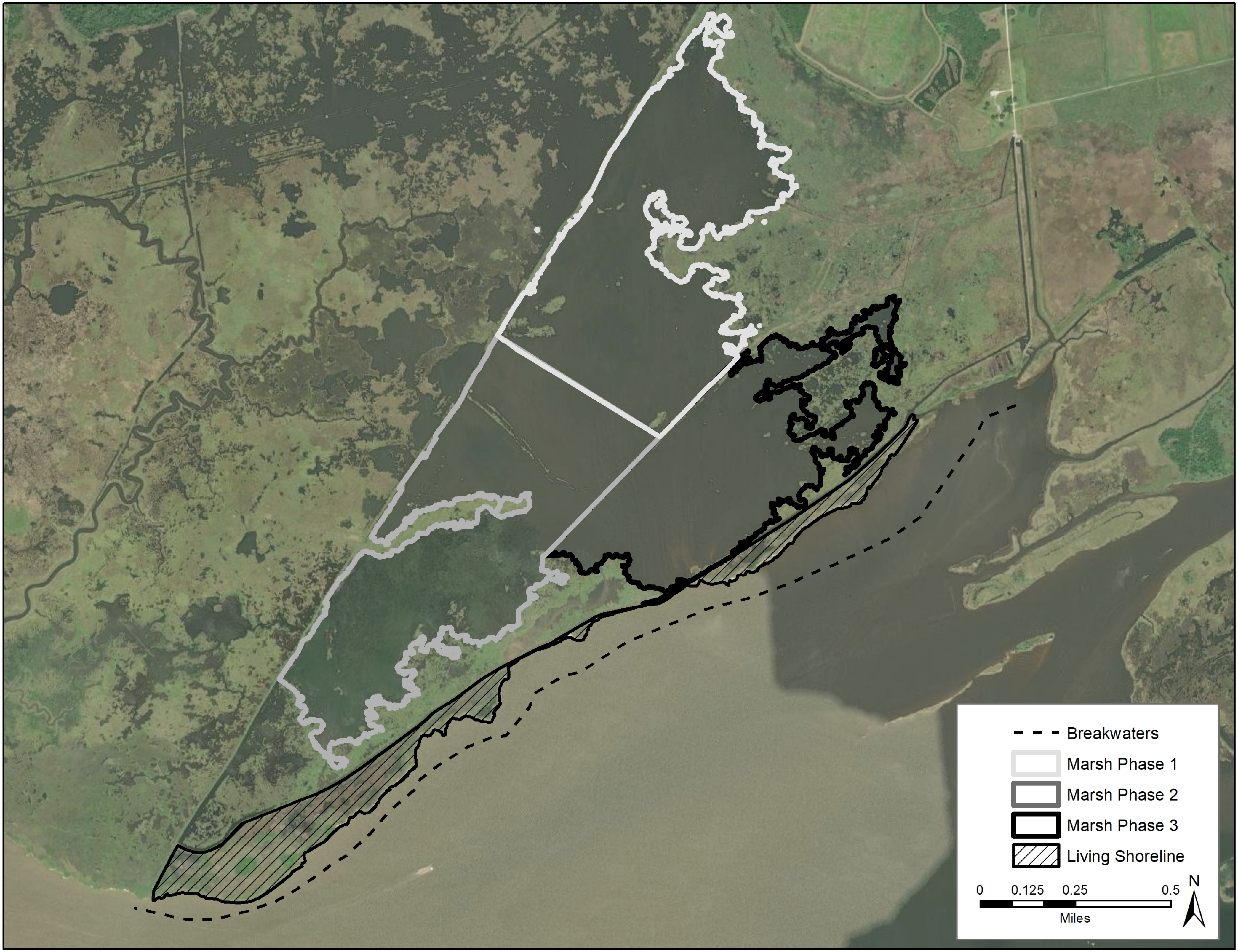

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Marsh Phase 3
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From:	noreply@thc.state.tx.us
To:	Rodgers, Jacqueline; reviews@thc.state.tx.us; Androy, Jerry L CIV USARMY CESWG (USA)
Subject:	[Non-DoD Source] Section 106 Submission
Date:	Monday, October 25, 2021 11:55:58 AM

Re: Project Review under Section 106 of the National Historic Preservation Act and/or the Antiquities Code of Texas
THC Tracking #202200866
Date: 10/25/2021
Hickory Cove Marsh Restoration
UTM 15N 421893E 3318528N
Bridge City,TX 77611

Description: Dredge from the Sabine-Neches Waterway will restore 650 acres of marsh and native plantings to restore 95 acres of shoreline. Existing levee repair and installation of a rock breakwater for erosion

Dear Jackie Rodgers:
Thank you for your submittal regarding the above-referenced project. This response represents the comments of the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission (THC), pursuant to review under Section 106 of the National Historic Preservation Act and the Antiquities Code of Texas.

The review staff, led by Marie Archambeault, Amy Borgens, Caitlin Brashear, has completed its review and has made the following determinations based on the information submitted for review:

Archeology Comments

- An archeological survey is required. You may obtain lists of archeologists in Texas through the Council of Texas Archeologists and the Register of Professional Archaeologists. Please note that other qualified archeologists not included on these lists may be used. If this work will occur on land owned or controlled by a state agency or political subdivision of the state, a Texas Antiquities Permit must be obtained from this office prior to initiation of fieldwork. All fieldwork should meet the Archeological Survey Standards for Texas. A report of investigations is required and should be produced in conformance with the Secretary of the Interior's Guidelines for Archaeology and Historic Preservation and submitted to this office for review. Reports for a Texas Antiquities Permit should also meet the Council of Texas Archeologists Guidelines for Cultural Resources Management Reports and the Texas Administrative Code. In addition, any buildings 45 years old or older that are located on or adjacent to the tract should be documented with photographs and included in the report. To facilitate review and make project information available through the Texas Archeological Sites Atlas, we appreciate emailing survey area shapefiles to

archeological_projects@thc.texas.gov concurrently with submission of the draft report. Please note that this is required for projects conducted under a Texas Antiquities Permit.
• THC/SHPO unable to complete review for the underwater project area at this time based on insufficient documentation. A supplemental review must be submitted, and the 30-day review period will begin upon receipt of adequate documentation.

We have the following comments: Additional information and images are needed regarding construction of the breakwater. Please describe the construction process and access to the project area. Will temporary barge channels be created? Include figures that show the specific location of the breakwater and discuss its materials, size, and attributes. Will there be an associated staging area for construction activities? Additionally, an archeological survey from 1970s does not follow modern survey standards and the project area should be re-surveyed using modern survey methods. Further, our records indicate that the previously recorded sites in the project area have an undetermined NRHP status.

We look forward to further consultation with your office and hope to maintain a partnership that will foster effective historic preservation. Thank you for your cooperation in this review process, and for your efforts to preserve the irreplaceable heritage of Texas. If the project changes, or if new historic properties are found, please contact the review staff. If you have any questions concerning our review or if we can be of further assistance, please email the following reviewers: marie.archambeault@thc.texas.gov, amy.borgens@thc.texas.gov, caitlin.brashear@thc.texas.gov.

This response has been sent through the electronic THC review and compliance system (eTRAC). Submitting your project via eTRAC eliminates mailing delays and allows you to check the status of the review, receive an electronic response, and generate reports on your submissions. For more information, visit http://thc.texas.gov/etrac-system.

Sincerely,

for Mark Wolfe, State Historic Preservation Officer
Executive Director, Texas Historical Commission

Please do not respond to this email.

cc: Jerry.L.Androy@usace.army.mil

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

September 27, 2021

Subject: Hickory Cove Marsh Restoration and Living Shoreline Project Coordination

Ms. Terri Parton
President
Wichita and Affiliated Tribes
Post Office Box 729
Anadarko, OK 73005

Dear Ms. Parton:

The U.S. Army Corps of Engineers (USACE), in partnership with the Orange County Navigation and Port District (non-federal sponsor for the project), is preparing a draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) for the Hickory Cove Marsh Restoration and Living Shoreline Project in Orange County, Texas, UTM 15N 421893E 3318528N. The study was authorized by Section 1122 of the Water Resources Development Act of 2016 which requires the USACE to establish a pilot program to carry out projects for the beneficial use of dredged material. The Hickory Cove Marsh Restoration and Living Shoreline Project was selected by the Office of the Assistant Secretary of the Army for Civil Works to be one of the pilot projects. This project includes the beneficial use of dredged maintenance material from the Sabine-Neches Waterway to restore approximately 650 acres of marsh within an existing 1200-acre impoundment and native plantings along 95 acres of adjacent coastline to create a living shoreline feature. The project also includes repairs to the existing containment levee and the installation of a rock breakwater adjacent to the shoreline to combat wave erosion (see enclosed maps). The marsh restoration is expected to require several dredge cycles to complete. The first dredge cycle is anticipated to begin in 2023 and will discharge 1.3 million cubic yards of maintenance dredged material to restore approximately 190 acres of marsh habitat.

Currently, the shoreline in the project area has eroded due to wave action and navigation traffic. Much of the shoreline has experienced significant loss, to the point that the containment levee surrounding the marsh has been breached. This has allowed estuary water to enter the marshes, where sediments are continually eroding and has converted approximately 80 percent of the project area to open water.

The study area was examined for any known historic properties using the Texas Historical Commission's (Atlas) database. This review found nine previous terrestrial cultural resource surveys and five maritime cultural resources surveys within the focused study area. The area for the proposed living shoreline has been surveyed in its

entirety; however, the areas proposed for the breakwater and the interior portions of the existing impoundment have not been previously surveyed.

Twenty-two previously recorded sites have been identified in the focused study area. Sixteen of those sites are within the living shoreline area that will be directly impacted by the project. Sites within the living shoreline area include: 41OR17, 41RO18, 41OR19, 41OR20, 41OR21, 41OR29, 41OR30, 41OR31, 41OR32, 41OR33, 41OR43, 41OR44, 41OR45, 41OR46, 41OR47, and 41OR48. Sites within the focused study area that will not be directly impacted include: 41OR41, 41OR75, 41OR79, 41JF18, 41JF19, and 41JF20. All locations within the focused study area are shell middens that have not been evaluated for the National Register of Historic Places (NRHP). Twenty sites were recorded in 1940 as many were being mined for the shell. Site 41OR33 was recorded in 1956 as it was actively being destroyed for shell mining. Site 41OR79 was recorded in 1973, and it was noted that a large portion of the site had been removed during dredging activities.

Five additional sites, including 41OR36, an unevaluated shell midden; 41OR73 an ineligible surface shell scatter; 41OR74, an unevaluated destroyed shell midden; 41OR77, an unevaluated shell midden; and 41JF17, an unevaluated shell midden, are located within 1-kilometer of the focused study area. No historic properties or districts listed on the NRHP or cemeteries are present within the focused study area or within 1-kilometer of the concentrated study area. Two Texas historical markers for the Rainbow Bridge (11509 and 10555, respectively) are located within 1-kilometer of the focused study area. The levee surrounding the marsh is less than 50 years old and is not eligible for consideration for the NRHP.

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Thank you for your cooperation in this review process. If you have any questions concerning this project or need further assistance, please contact Jackie Rodgers, Archaeologist, Regional Environmental Planning Center at (918) 669-4964 or via email at Jacqueline.Rodgers@usace.army.mil. Your comments would be appreciated within 30 days of receipt of this letter.

Sincerely,

Amanda McGuire

Amanda M. McGuire
Chief, Environmental Branch
Regional Planning and Environmental
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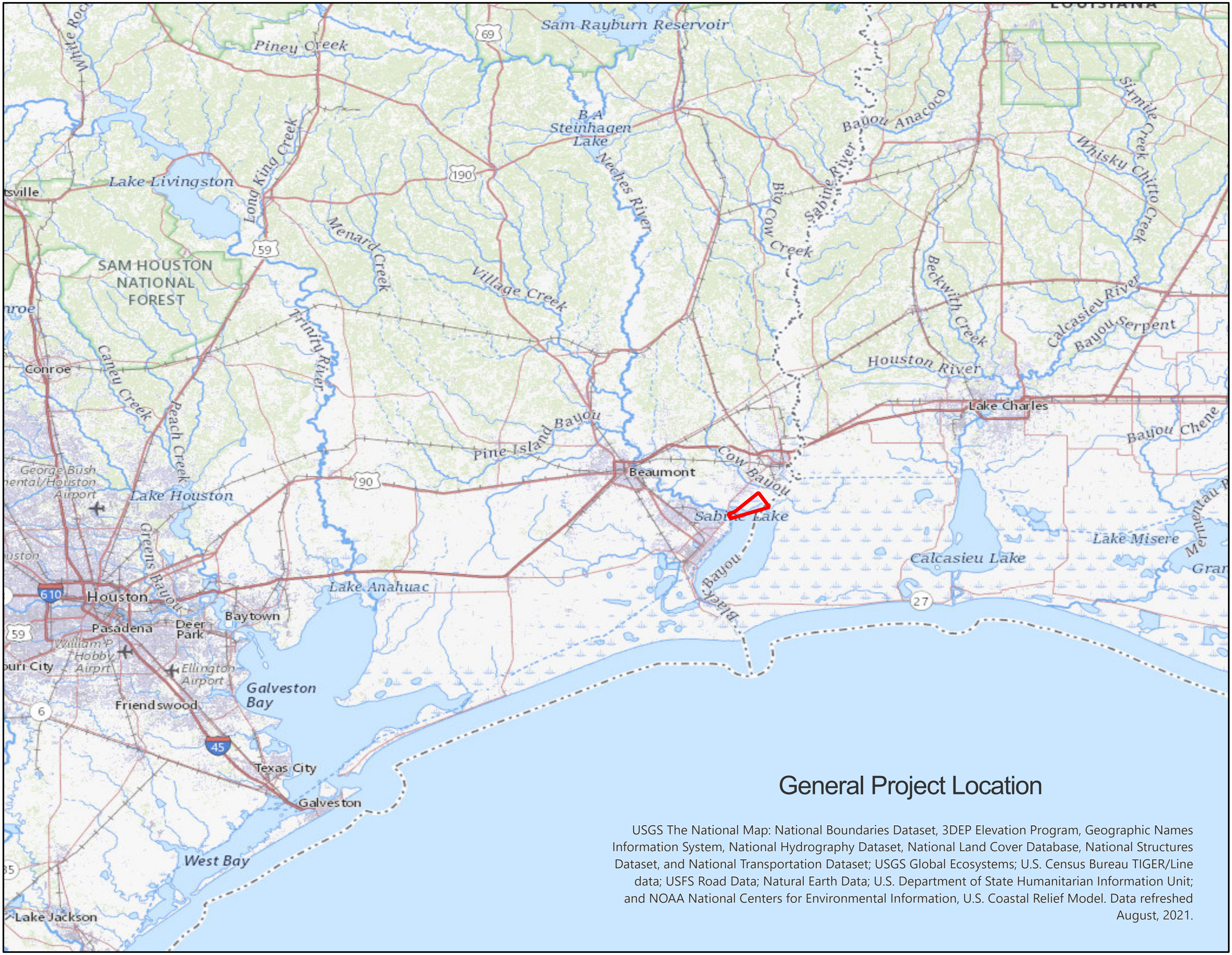
Enclosures



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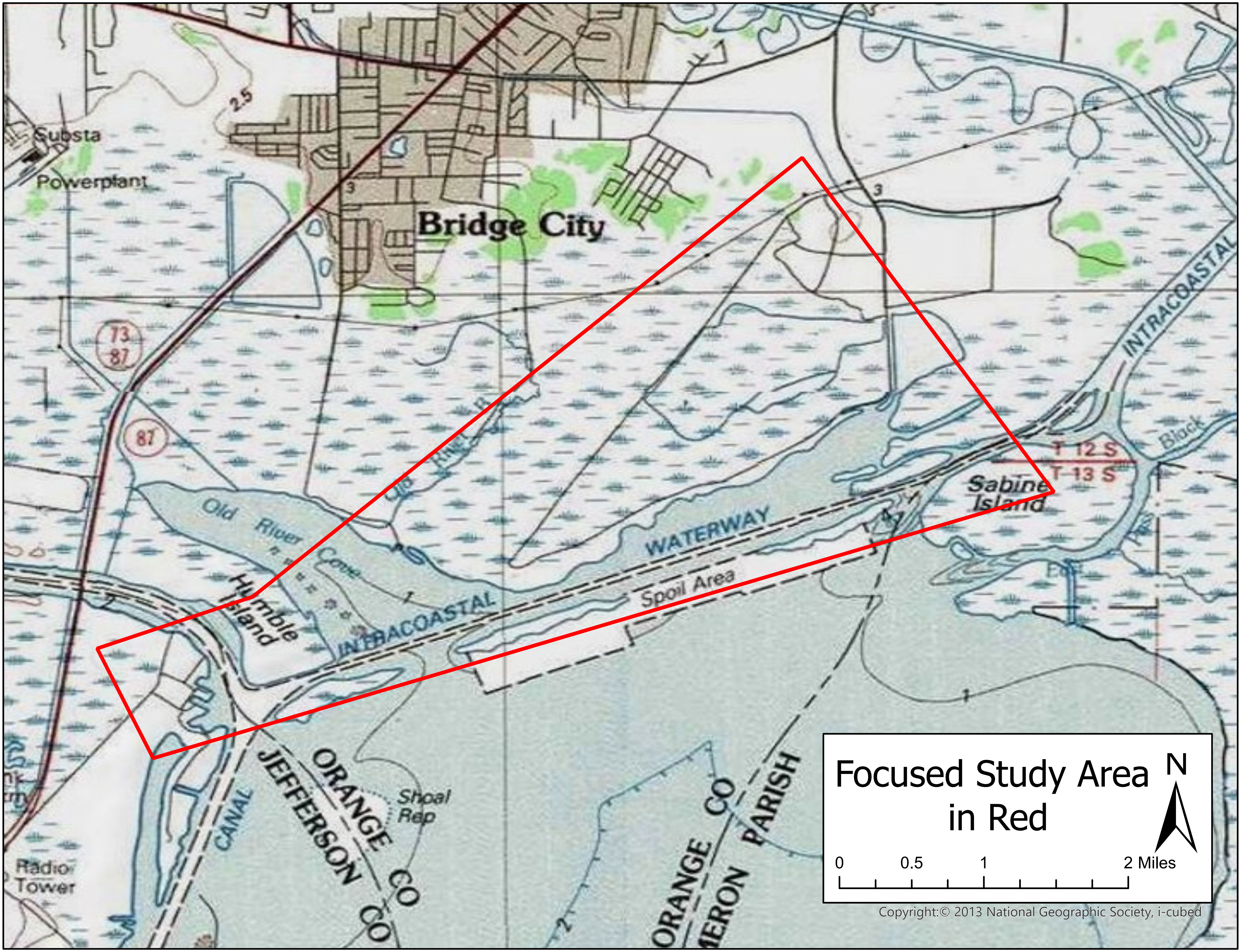
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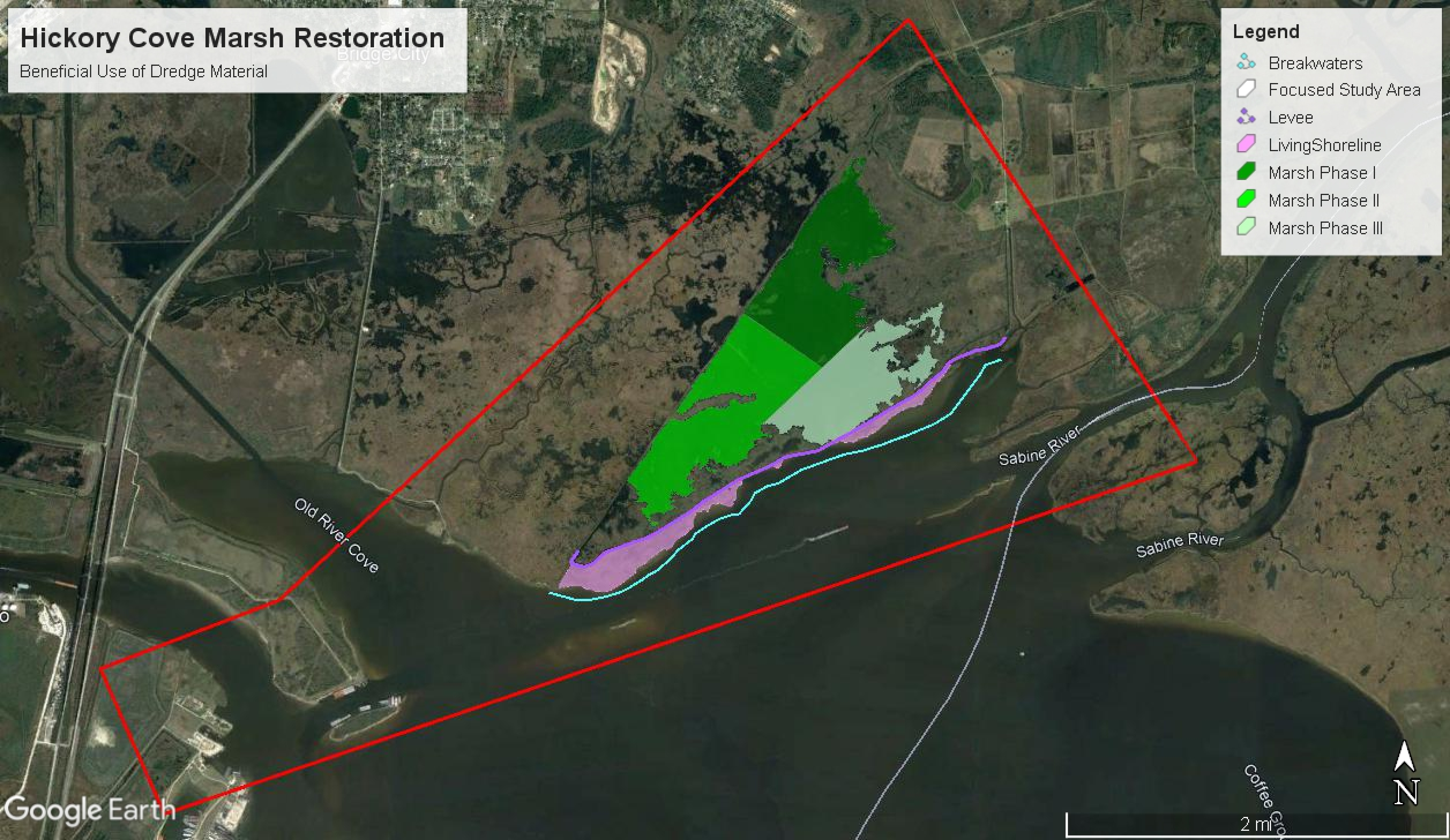
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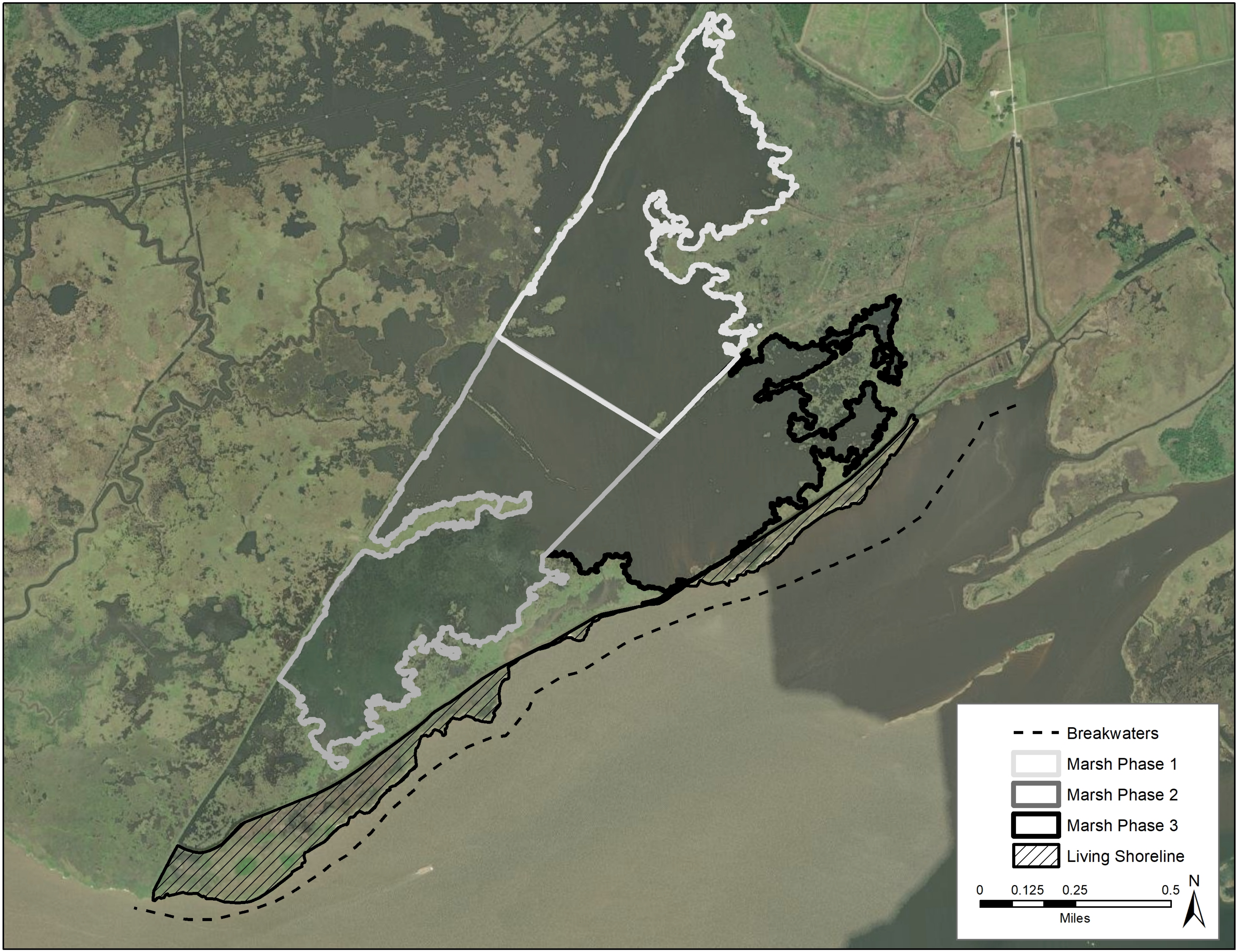

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From:	Gary McAdams
To:	Rodgers, Jacqueline
Subject:	[Non-DoD Source] RE: Hickory Cove Marsh Restoration Project
Date:	Tuesday, September 28, 2021 8:30:02 AM
Attachments:	Counties Important to the Wichita final.docx

Good Morning Jackie,

Thank you for your offer of consultation. Orange County, TX is outside the Tribe's area of interest. Therefore, we do not wish to be a consulting party on the referenced project. I'm attaching a list of counties from several states within our area of interest for your future reference.

Gary McAdams
Cultural Program Planner/THPO
Wichita and Affiliated Tribes

From: Rodgers, Jacqueline <Jacqueline.Rodgers@usace.army.mil>
Sent: Monday, September 27, 2021 5:05 PM
To: Gary McAdams <gary.mcadams@wichitatribe.com>
Subject: Hickory Cove Marsh Restoration Project

Good afternoon,

Please find attached a Section 106 submission for consultation for the Hickory Cove marsh restoration project in Orange County, Texas. If you have any concerns or questions on the project, please reach out to me at the contact information listed below.

Thank you,

Jackie Rodgers
Archaeologist
Regional Planning & Environmental Center (RPEC)
Environmental Branch Compliance Section CESWF-PEE-C
Office: 918-669-4964
jacqueline.rodgers@usace.army.mil

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

September 27, 2021

Subject: Hickory Cove Marsh Restoration and Living Shoreline Project Coordination

Ms. Nita Battise
Council Chairwoman
Alabama-Coushatta Tribe of Texas
571 State Park Road 56
Livingston, TX 77351

Dear Ms. Battise:

The U.S. Army Corps of Engineers (USACE), in partnership with the Orange County Navigation and Port District (non-federal sponsor for the project), is preparing a draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) for the Hickory Cove Marsh Restoration and Living Shoreline Project in Orange County, Texas, UTM 15N 421893E 3318528N. The study was authorized by Section 1122 of the Water Resources Development Act of 2016 which requires the USACE to establish a pilot program to carry out projects for the beneficial use of dredged material. The Hickory Cove Marsh Restoration and Living Shoreline Project was selected by the Office of the Assistant Secretary of the Army for Civil Works to be one of the pilot projects. This project includes the beneficial use of dredged maintenance material from the Sabine-Neches Waterway to restore approximately 650 acres of marsh within an existing 1200-acre impoundment and native plantings along 95 acres of adjacent coastline to create a living shoreline feature. The project also includes repairs to the existing containment levee and the installation of a rock breakwater adjacent to the shoreline to combat wave erosion (see enclosed maps). The marsh restoration is expected to require several dredge cycles to complete. The first dredge cycle is anticipated to begin in 2023 and will discharge 1.3 million cubic yards of maintenance dredged material to restore approximately 190 acres of marsh habitat.

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Amanda McGuire

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Chief, Environmental Branch
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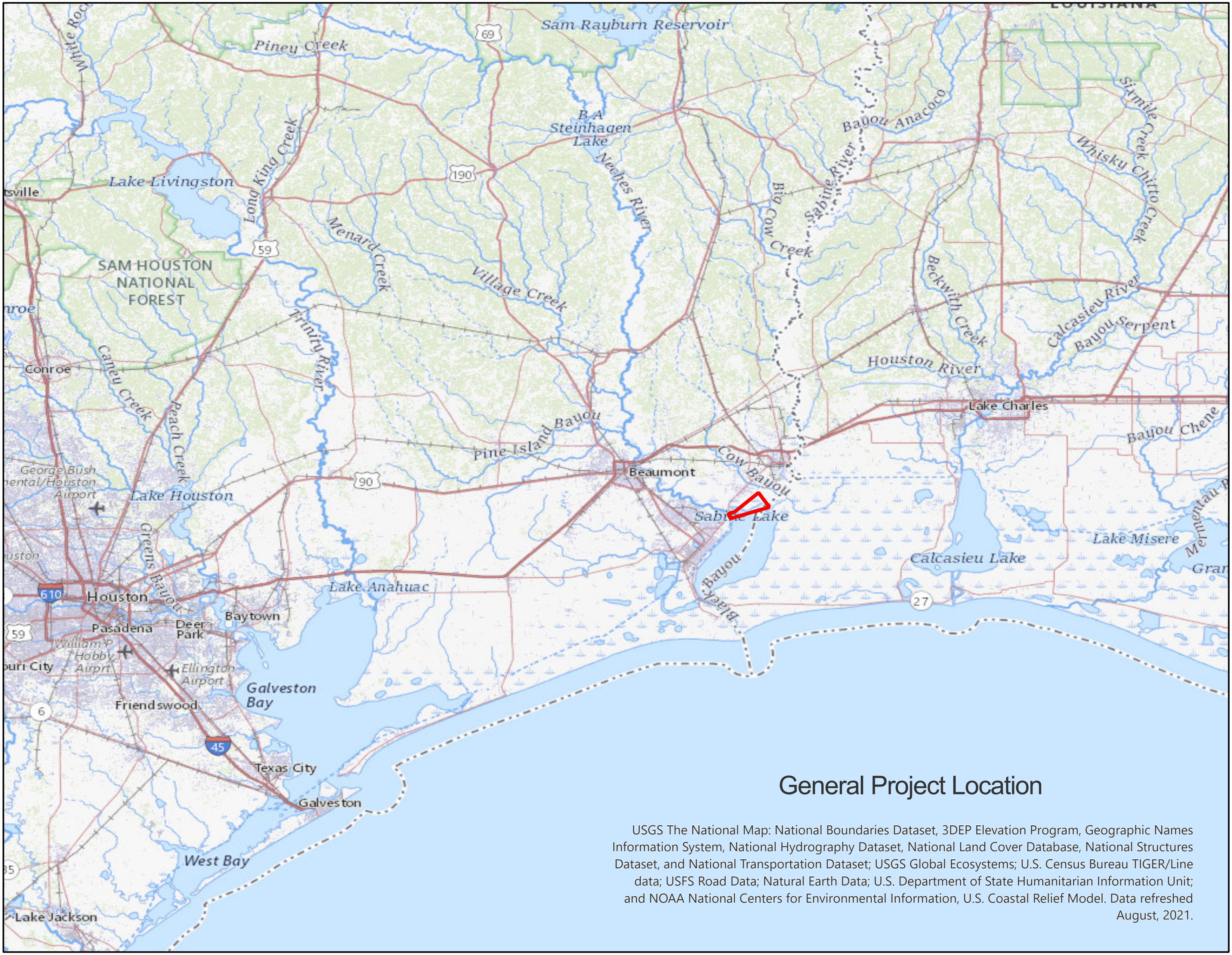
Enclosures



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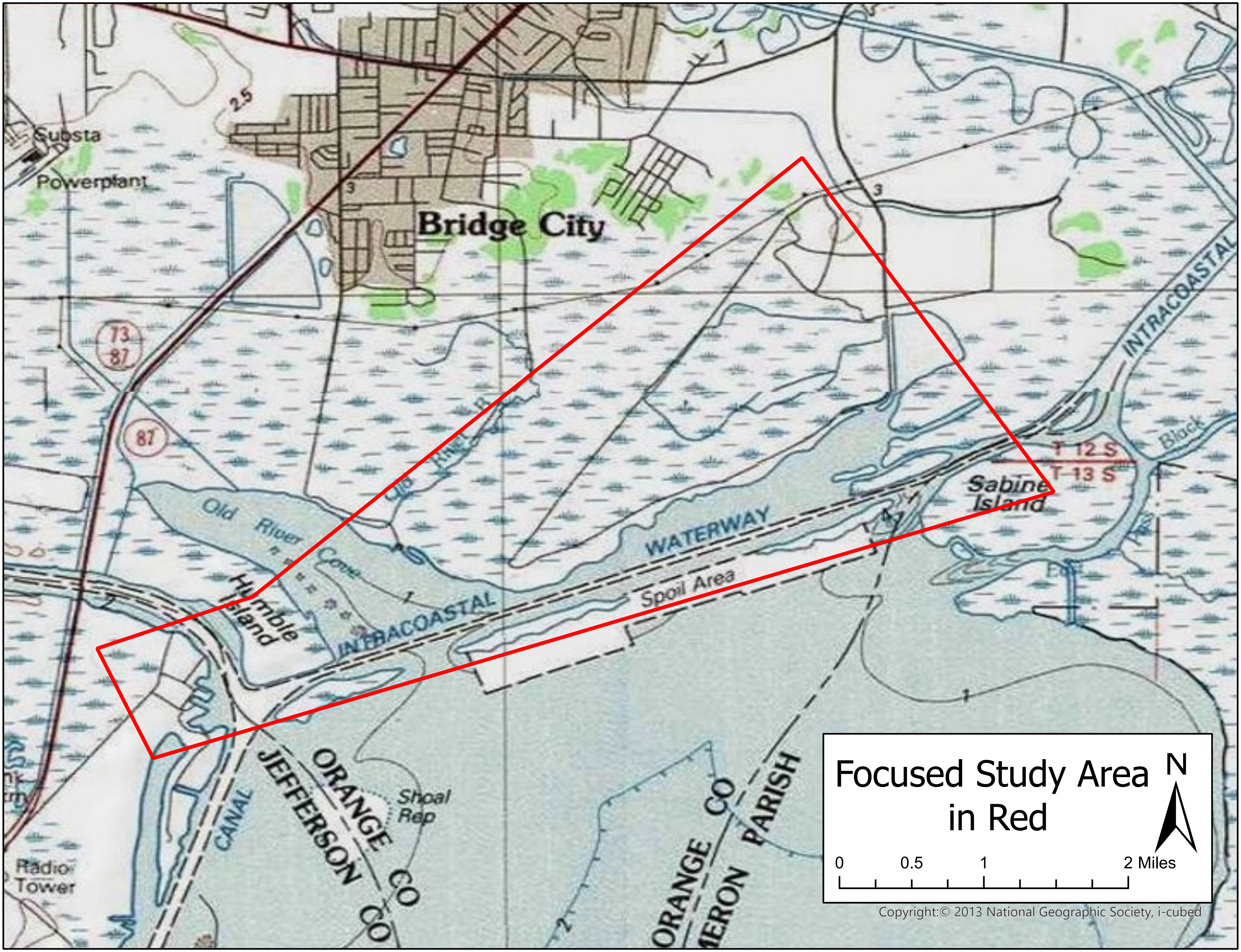
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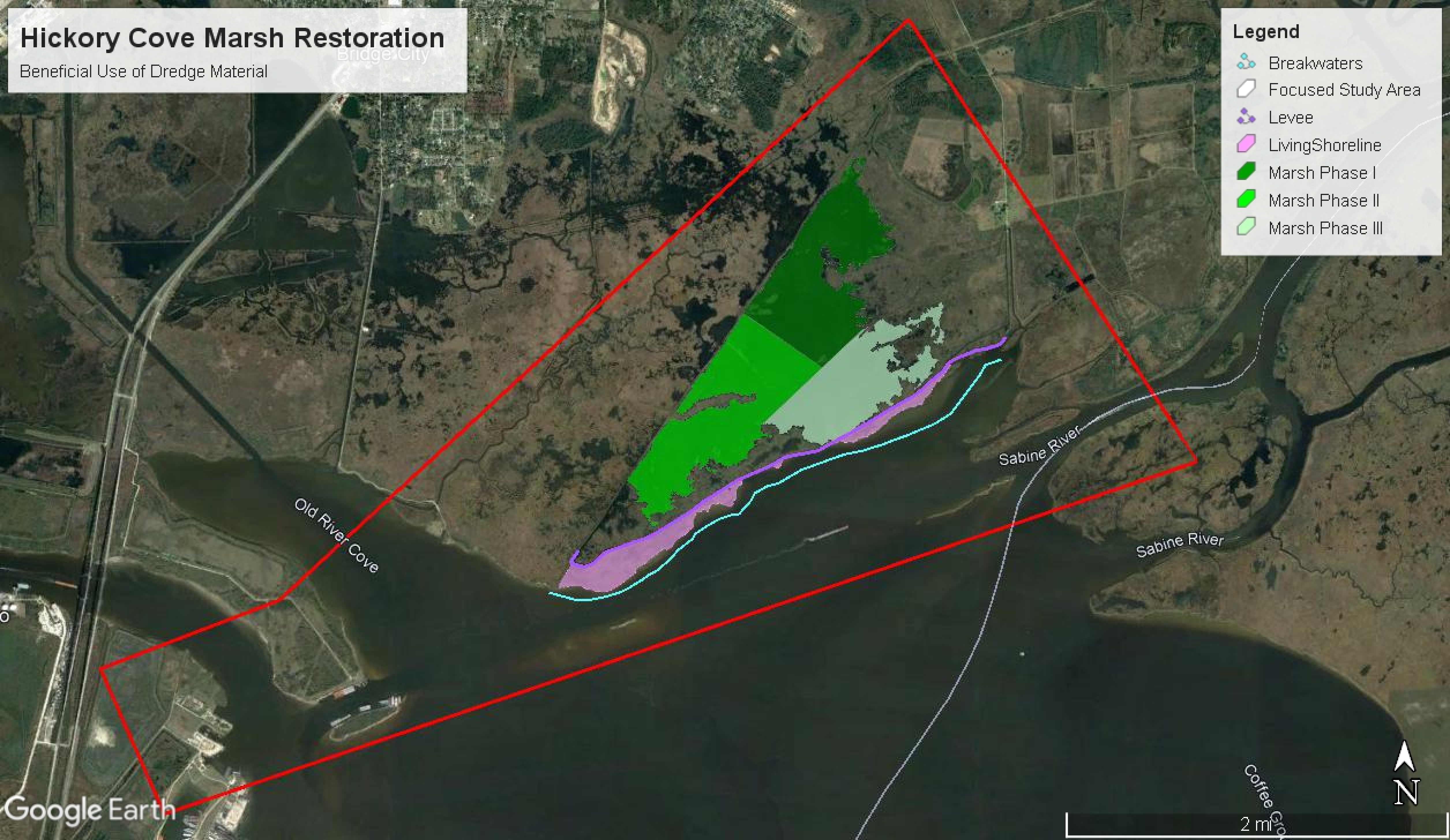

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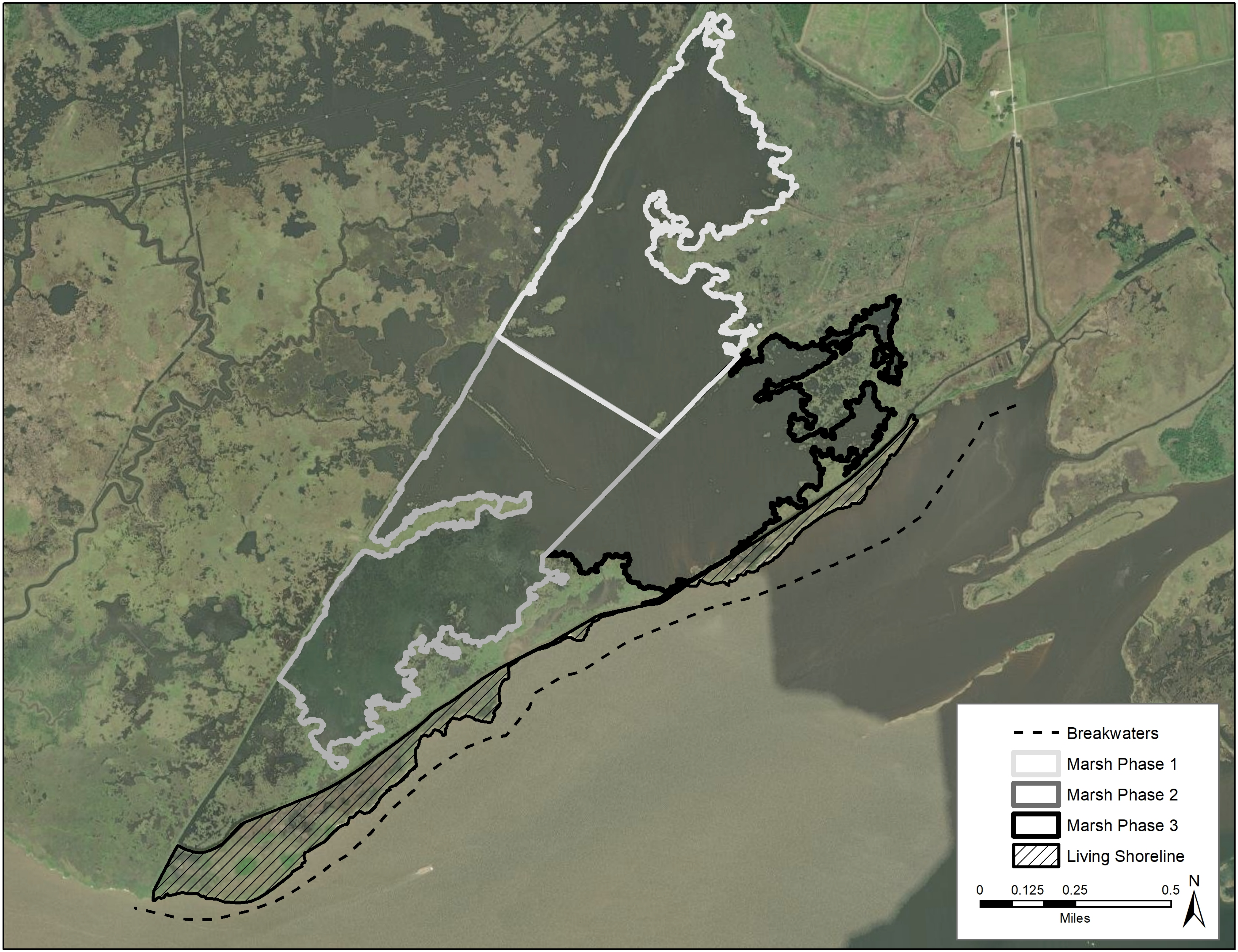
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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

September 27, 2021

Subject: Hickory Cove Marsh Restoration and Living Shoreline Project Coordination

Mr. Tarpie Yargee
Town King
Alabama-Quassarte Tribal Town
Post Office Box 187
Wetumka, OK 74883

Dear Mr. Yargee:

The U.S. Army Corps of Engineers (USACE), in partnership with the Orange County Navigation and Port District (non-federal sponsor for the project), is preparing a draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) for the Hickory Cove Marsh Restoration and Living Shoreline Project in Orange County, Texas, UTM 15N 421893E 3318528N. The study was authorized by Section 1122 of the Water Resources Development Act of 2016 which requires the USACE to establish a pilot program to carry out projects for the beneficial use of dredged material. The Hickory Cove Marsh Restoration and Living Shoreline Project was selected by the Office of the Assistant Secretary of the Army for Civil Works to be one of the pilot projects. This project includes the beneficial use of dredged maintenance material from the Sabine-Neches Waterway to restore approximately 650 acres of marsh within an existing 1200-acre impoundment and native plantings along 95 acres of adjacent coastline to create a living shoreline feature. The project also includes repairs to the existing containment levee and the installation of a rock breakwater adjacent to the shoreline to combat wave erosion (see enclosed maps). The marsh restoration is expected to require several dredge cycles to complete. The first dredge cycle is anticipated to begin in 2023 and will discharge 1.3 million cubic yards of maintenance dredged material to restore approximately 190 acres of marsh habitat.

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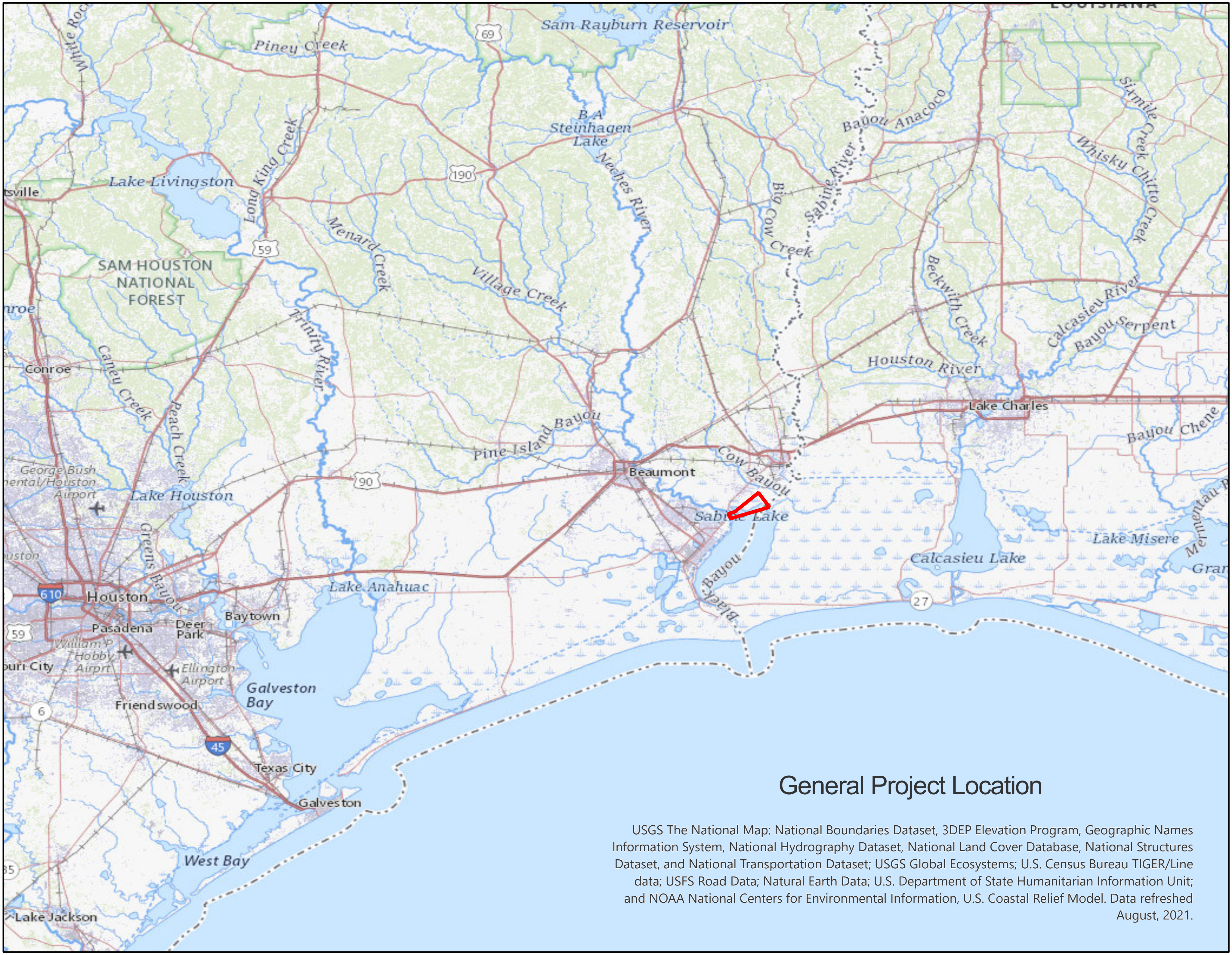
Sincerely,

Amanda McGuire

Amanda M. McGuire
Chief, Environmental Branch
Regional Planning and Environmental
Center

Enclosures



General Project Location

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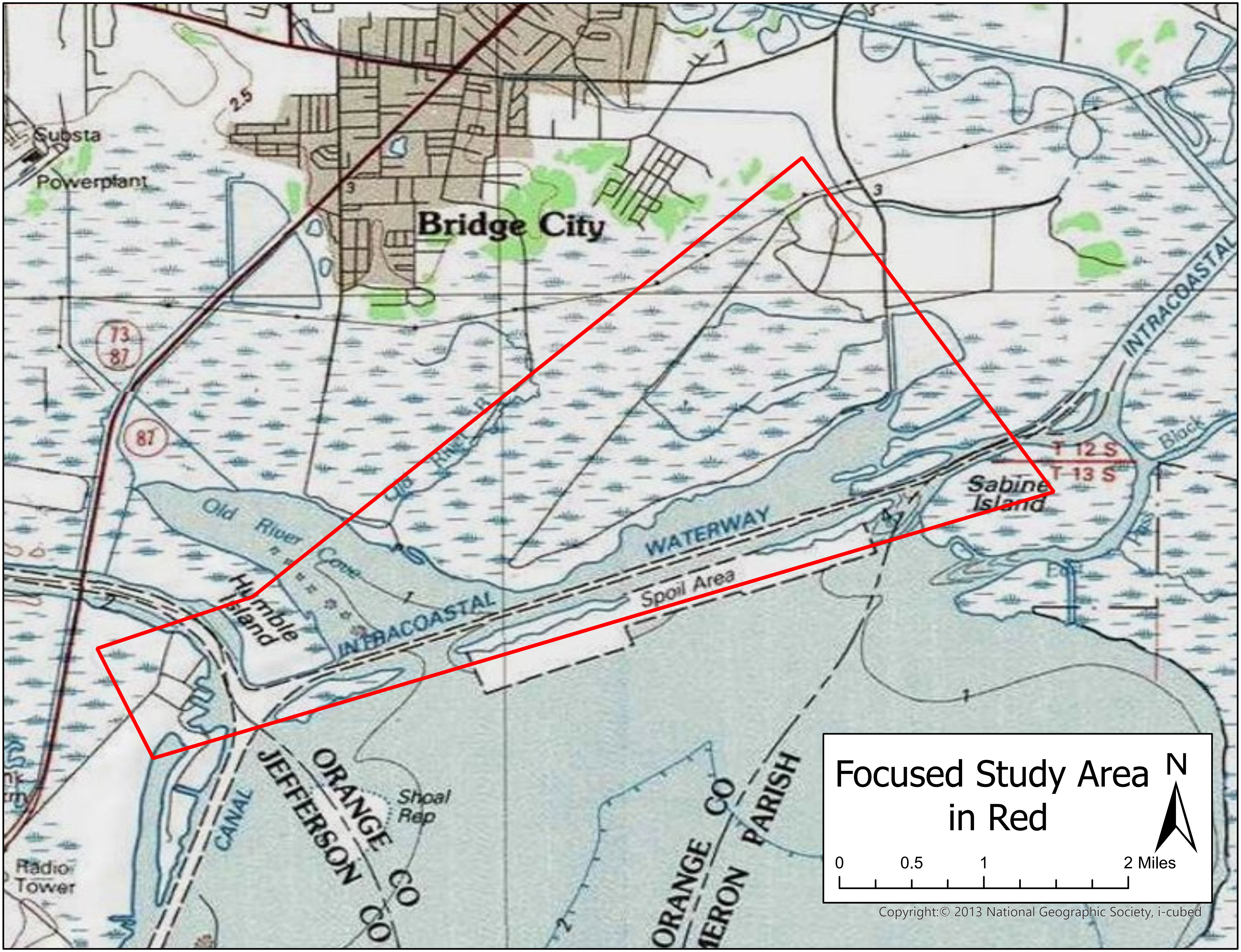
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Humble Island
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WATERWAY
Spoil Area
Sabine Island
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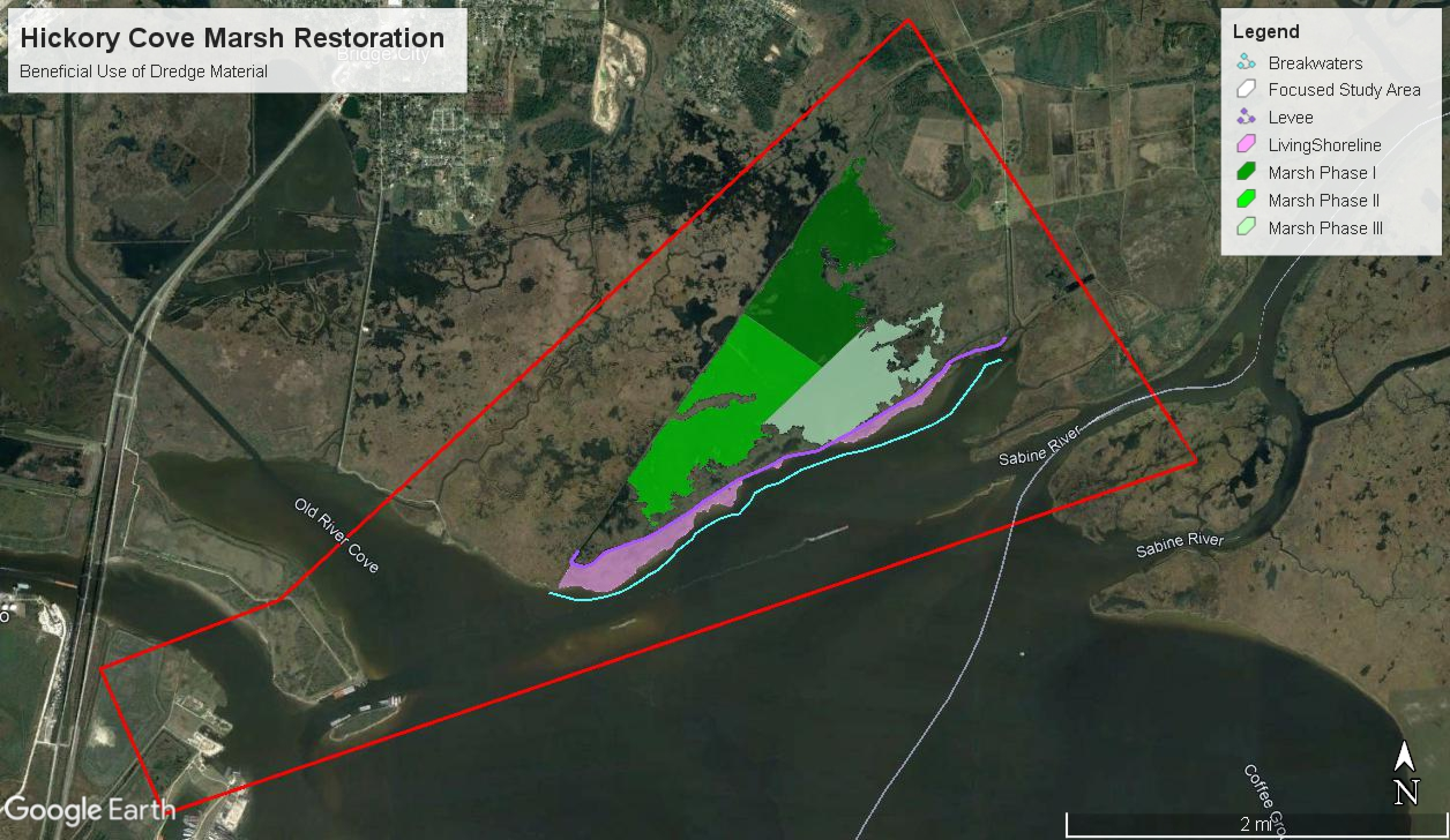

Hickory Cove Marsh Restoration
Beneficial Use of Dredge Material
Legend
Breakwaters
Focused Study Area
Levee
LivingShoreline
Marsh Phase I
Marsh Phase II
Marsh Phase III
Bridge City
Old River Cove
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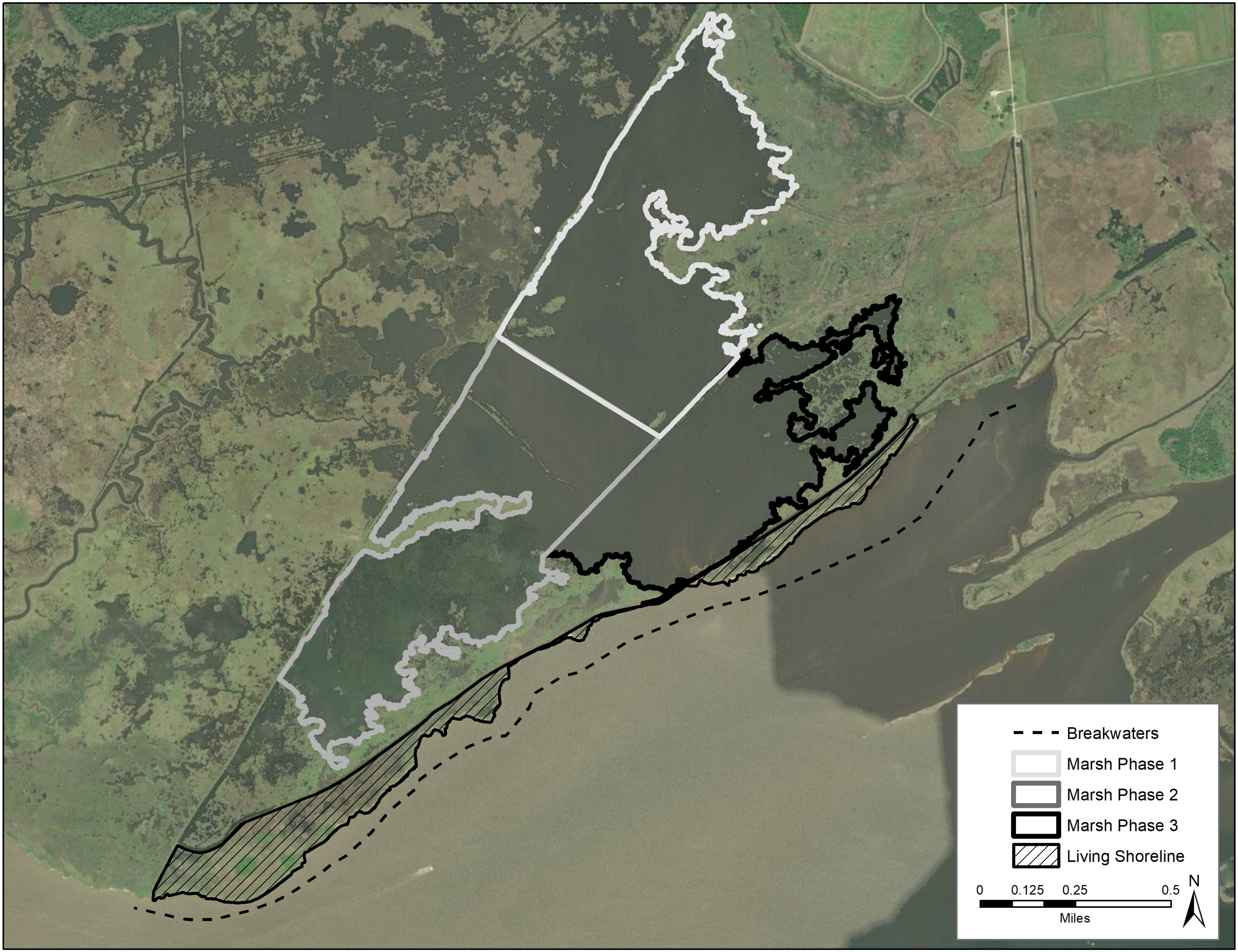

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Marsh Phase 1
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Living Shoreline
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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

September 27, 2021

Subject: Hickory Cove Marsh Restoration and Living Shoreline Project Coordination

Mr. Bobby Komardly
Chairman
Apache Tribe of Oklahoma
Post Office Box 1330
Anadarko, OK 73005

Dear Mr. Komardly:

The U.S. Army Corps of Engineers (USACE), in partnership with the Orange County Navigation and Port District (non-federal sponsor for the project), is preparing a draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) for the Hickory Cove Marsh Restoration and Living Shoreline Project in Orange County, Texas, UTM 15N 421893E 3318528N. The study was authorized by Section 1122 of the Water Resources Development Act of 2016 which requires the USACE to establish a pilot program to carry out projects for the beneficial use of dredged material. The Hickory Cove Marsh Restoration and Living Shoreline Project was selected by the Office of the Assistant Secretary of the Army for Civil Works to be one of the pilot projects. This project includes the beneficial use of dredged maintenance material from the Sabine-Neches Waterway to restore approximately 650 acres of marsh within an existing 1200-acre impoundment and native plantings along 95 acres of adjacent coastline to create a living shoreline feature. The project also includes repairs to the existing containment levee and the installation of a rock breakwater adjacent to the shoreline to combat wave erosion (see enclosed maps). The marsh restoration is expected to require several dredge cycles to complete. The first dredge cycle is anticipated to begin in 2023 and will discharge 1.3 million cubic yards of maintenance dredged material to restore approximately 190 acres of marsh habitat.

Currently, the shoreline in the project area has eroded due to wave action and navigation traffic. Much of the shoreline has experienced significant loss, to the point that the containment levee surrounding the marsh has been breached. This has allowed estuary water to enter the marshes, where sediments are continually eroding and has converted approximately 80 percent of the project area to open water.

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Regional Planning and Environmental
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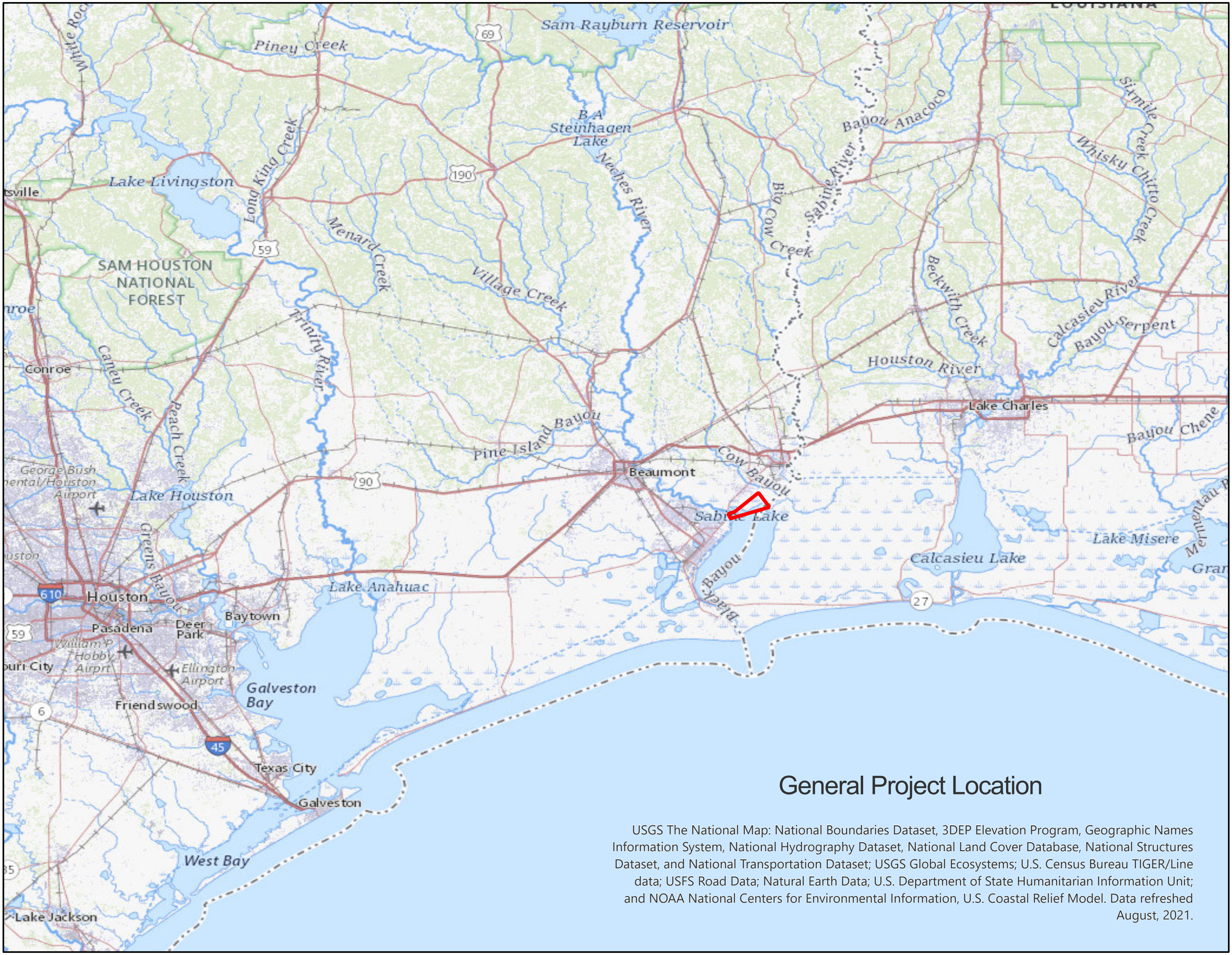
Enclosures



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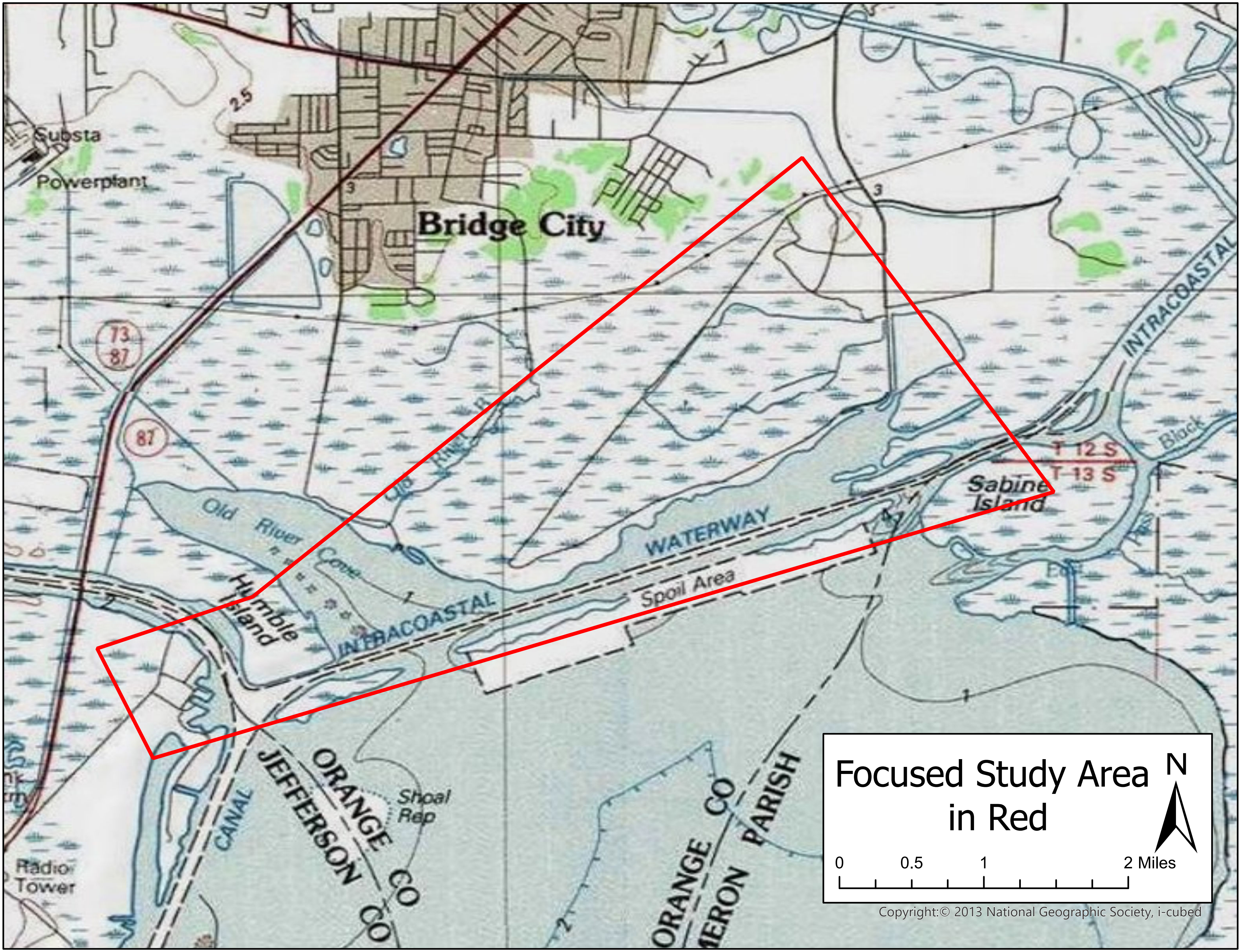
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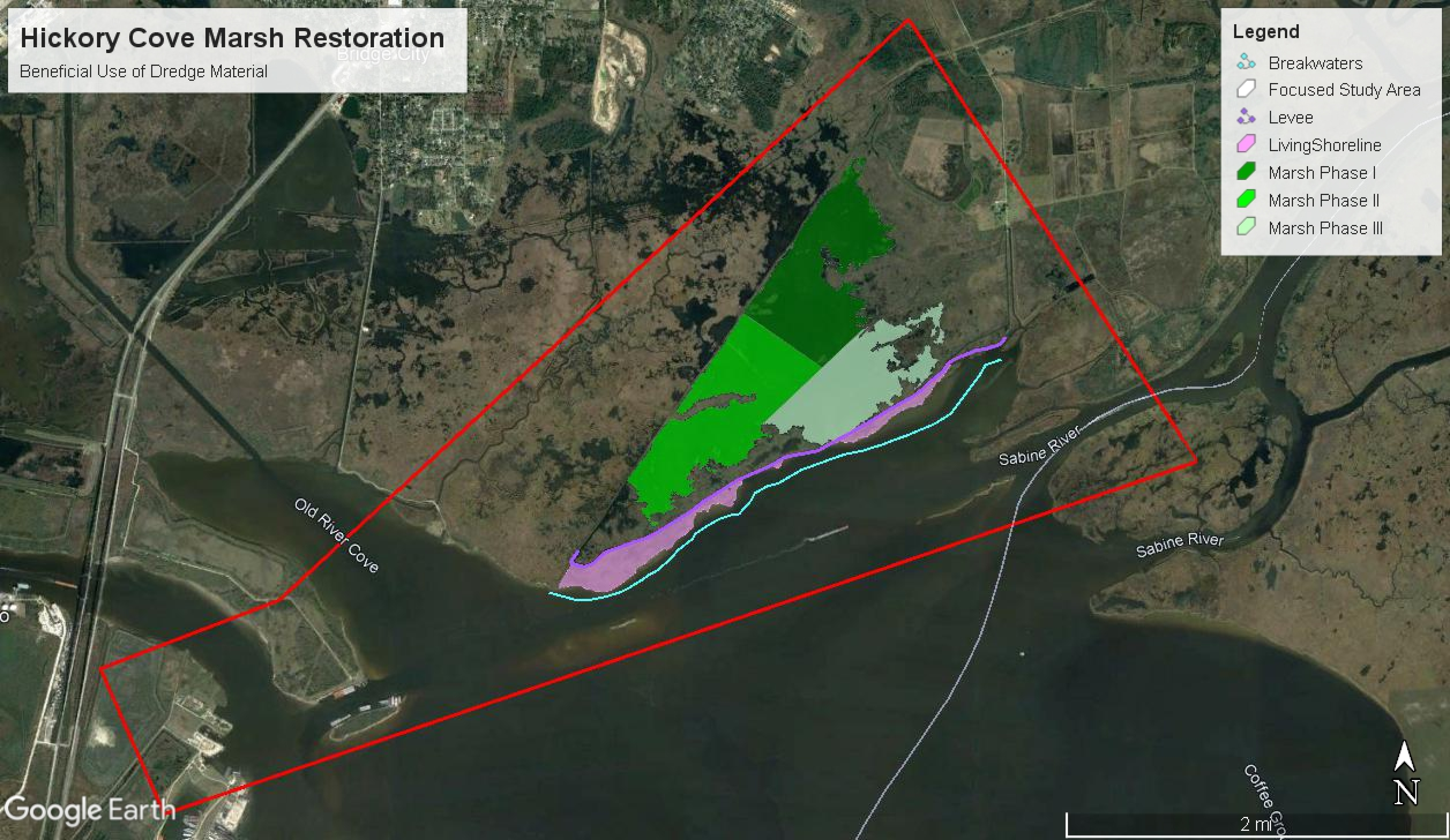
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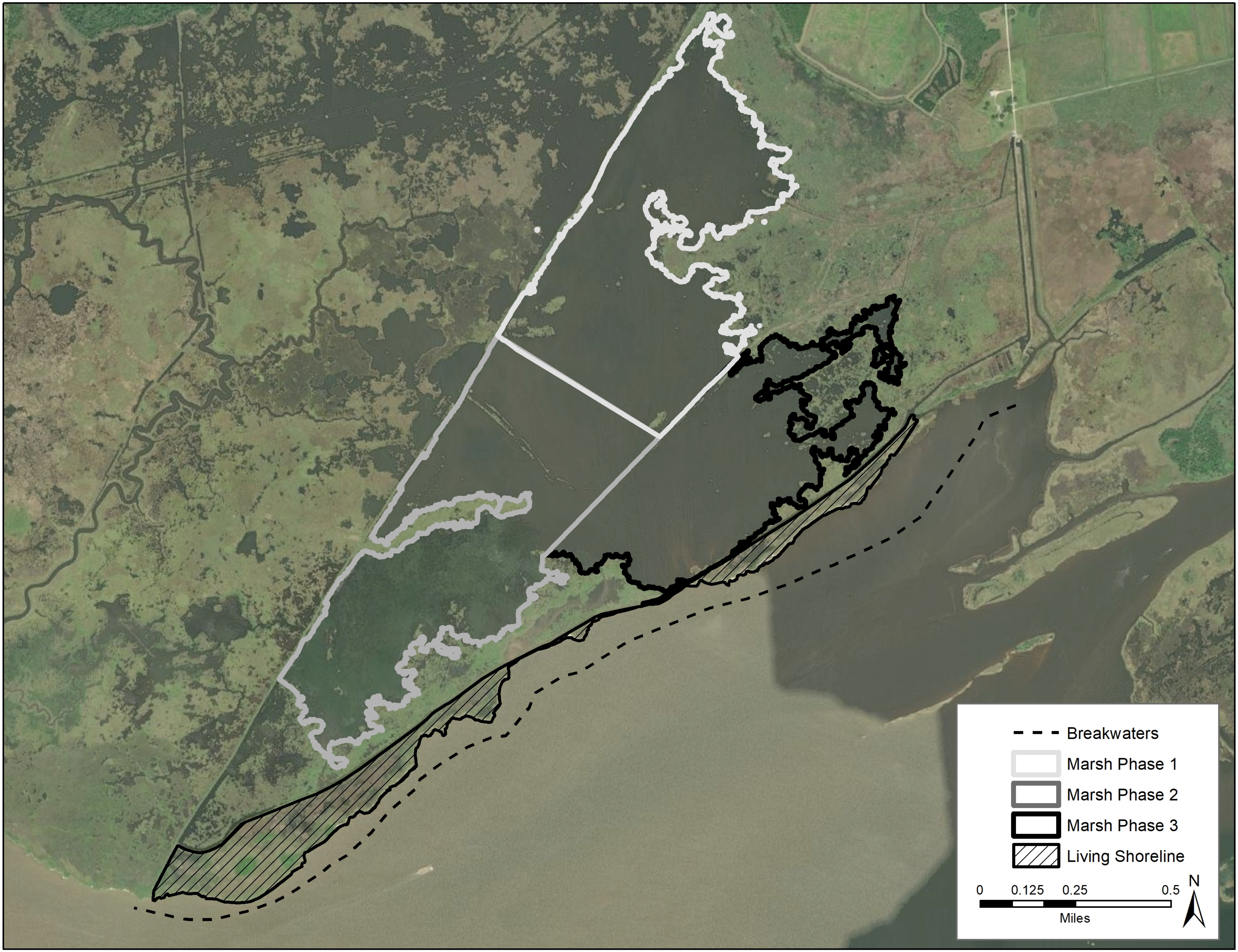

Breakwaters
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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

September 27, 2021

Subject: Hickory Cove Marsh Restoration and Living Shoreline Project Coordination

Mr. David Sickey
Chairman
Coushatta Tribe of Louisiana
Post Office Box 10
Elton, Louisiana 70532

Dear Mr. Sickey:

The U.S. Army Corps of Engineers (USACE), in partnership with the Orange County Navigation and Port District (non-federal sponsor for the project), is preparing a draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) for the Hickory Cove Marsh Restoration and Living Shoreline Project in Orange County, Texas, UTM 15N 421893E 3318528N. The study was authorized by Section 1122 of the Water Resources Development Act of 2016 which requires the USACE to establish a pilot program to carry out projects for the beneficial use of dredged material. The Hickory Cove Marsh Restoration and Living Shoreline Project was selected by the Office of the Assistant Secretary of the Army for Civil Works to be one of the pilot projects. This project includes the beneficial use of dredged maintenance material from the Sabine-Neches Waterway to restore approximately 650 acres of marsh within an existing 1200-acre impoundment and native plantings along 95 acres of adjacent coastline to create a living shoreline feature. The project also includes repairs to the existing containment levee and the installation of a rock breakwater adjacent to the shoreline to combat wave erosion (see enclosed maps). The marsh restoration is expected to require several dredge cycles to complete. The first dredge cycle is anticipated to begin in 2023 and will discharge 1.3 million cubic yards of maintenance dredged material to restore approximately 190 acres of marsh habitat.

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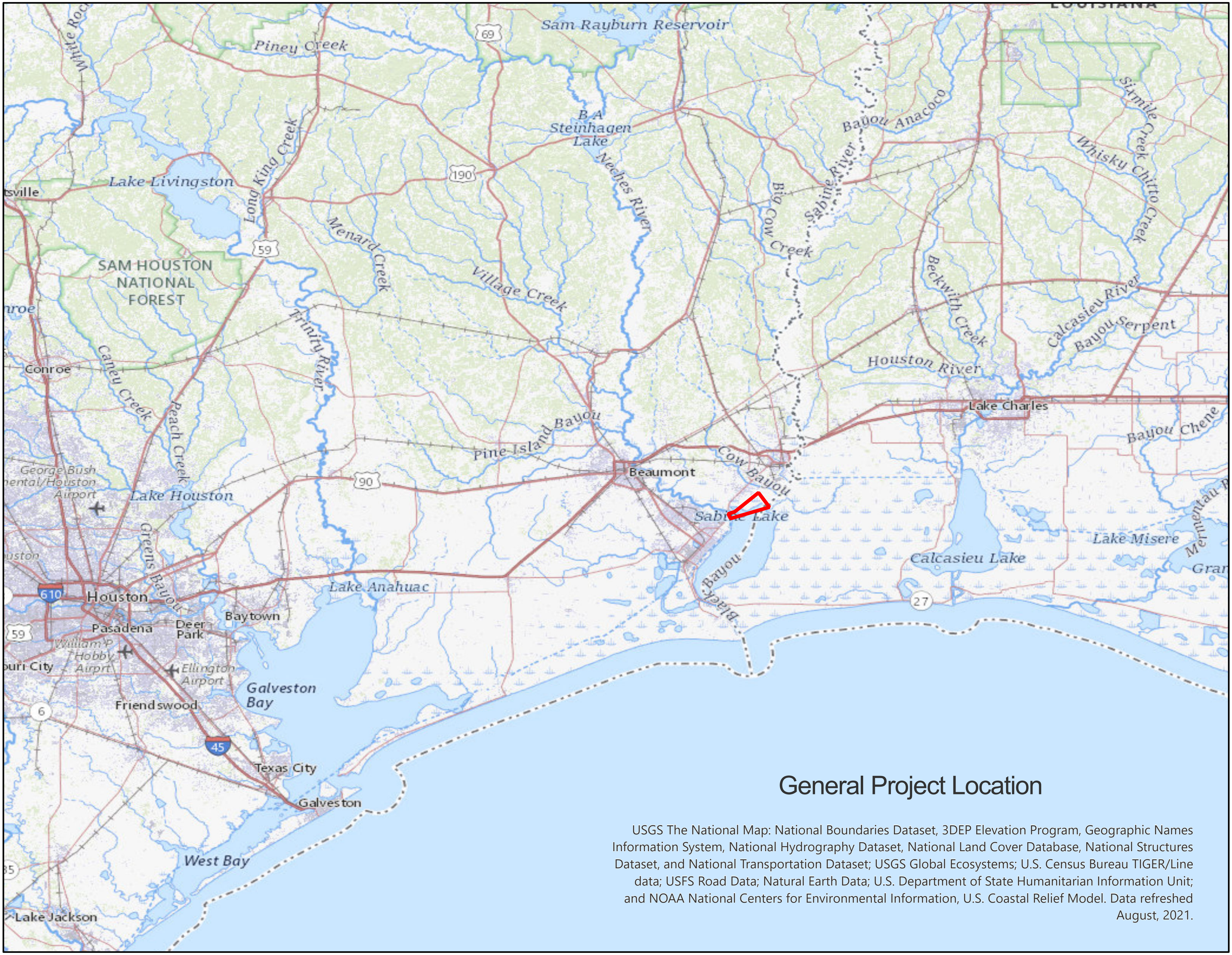

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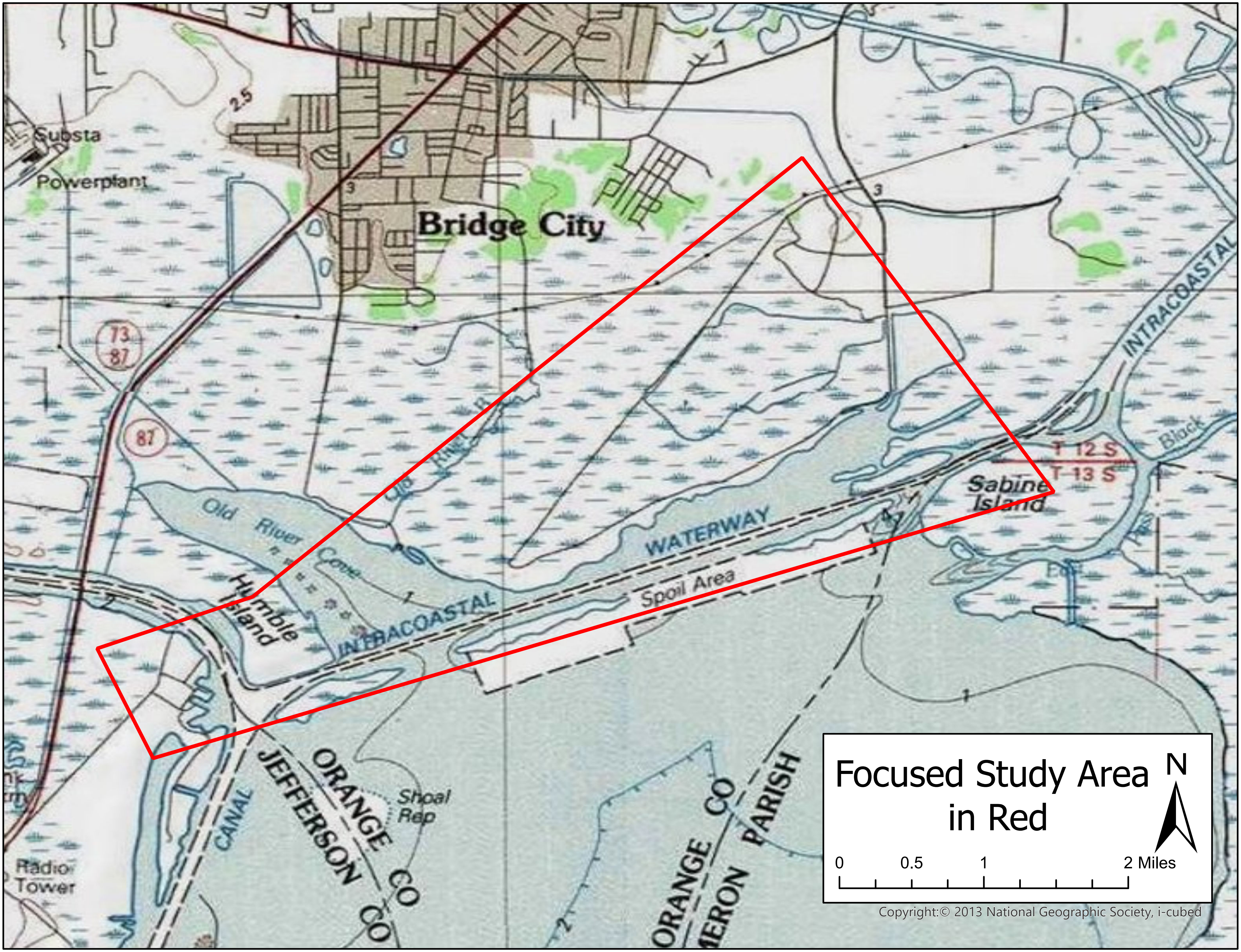
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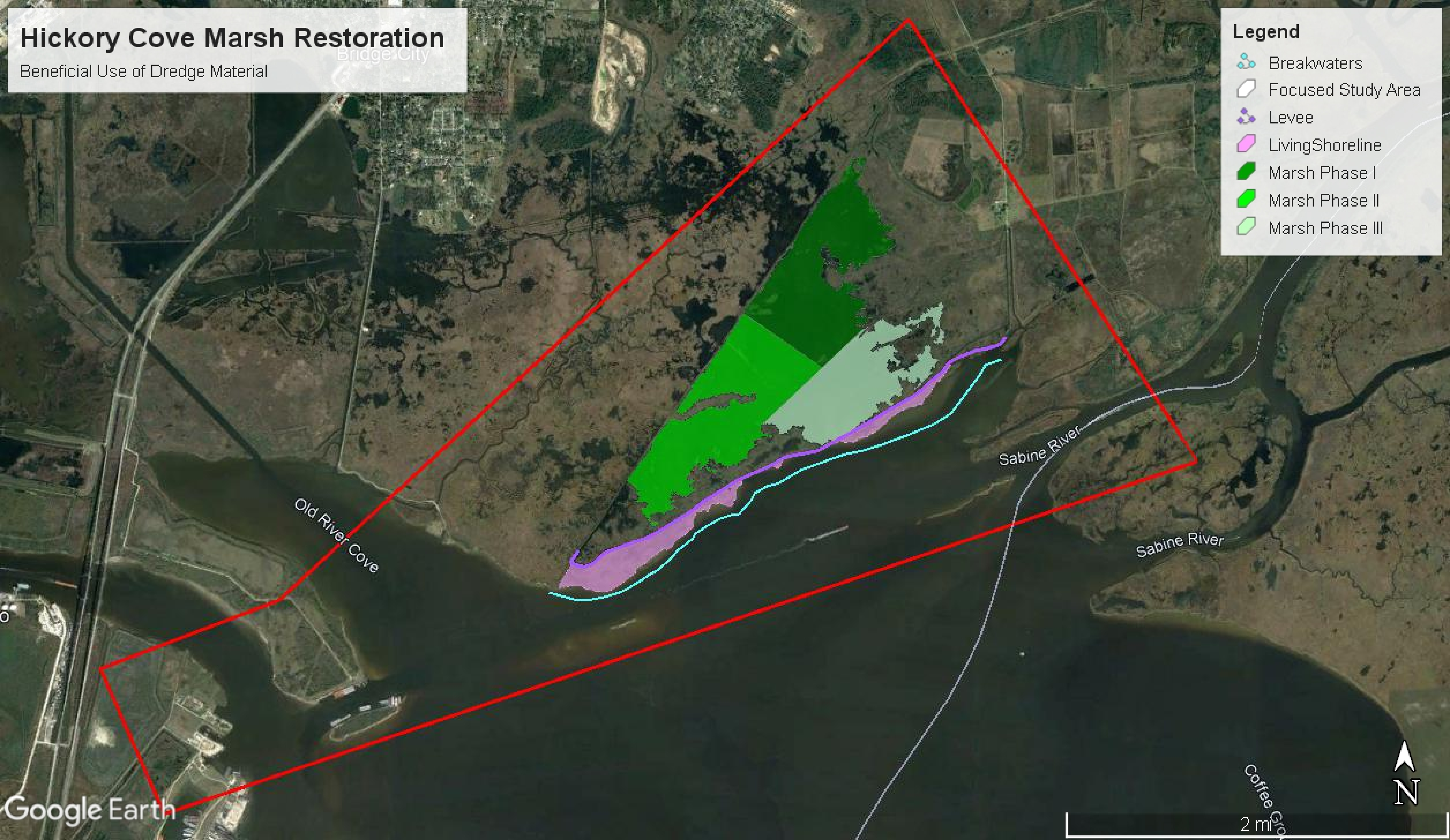
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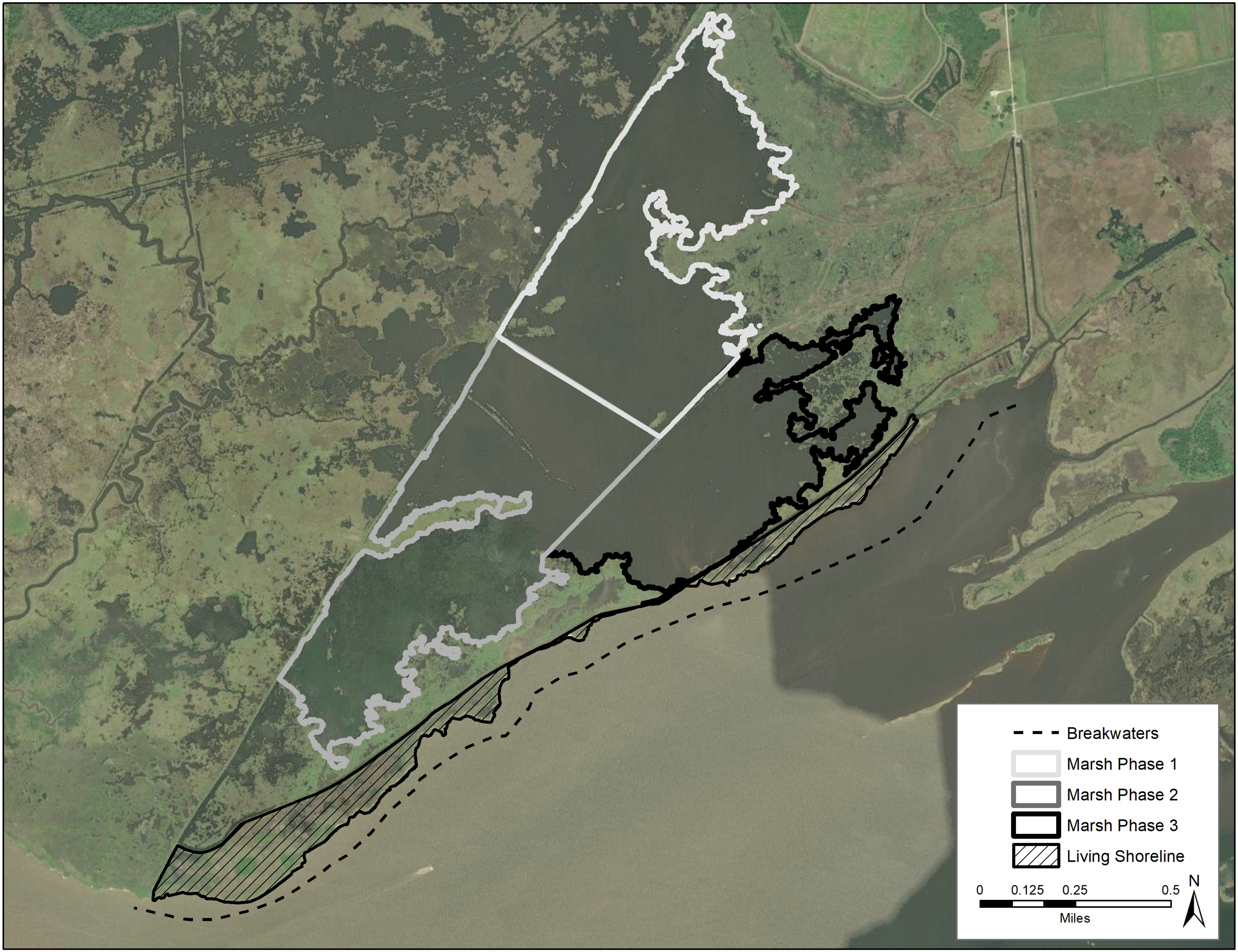
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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

September 27, 2021

Subject: Hickory Cove Marsh Restoration and Living Shoreline Project Coordination

Mr. Matthew M. Komalty
Chairman
Kiowa Indian Tribe of Oklahoma
Post Office Box 369
Carnegie, OK 73015

Dear Mr. Komalty:

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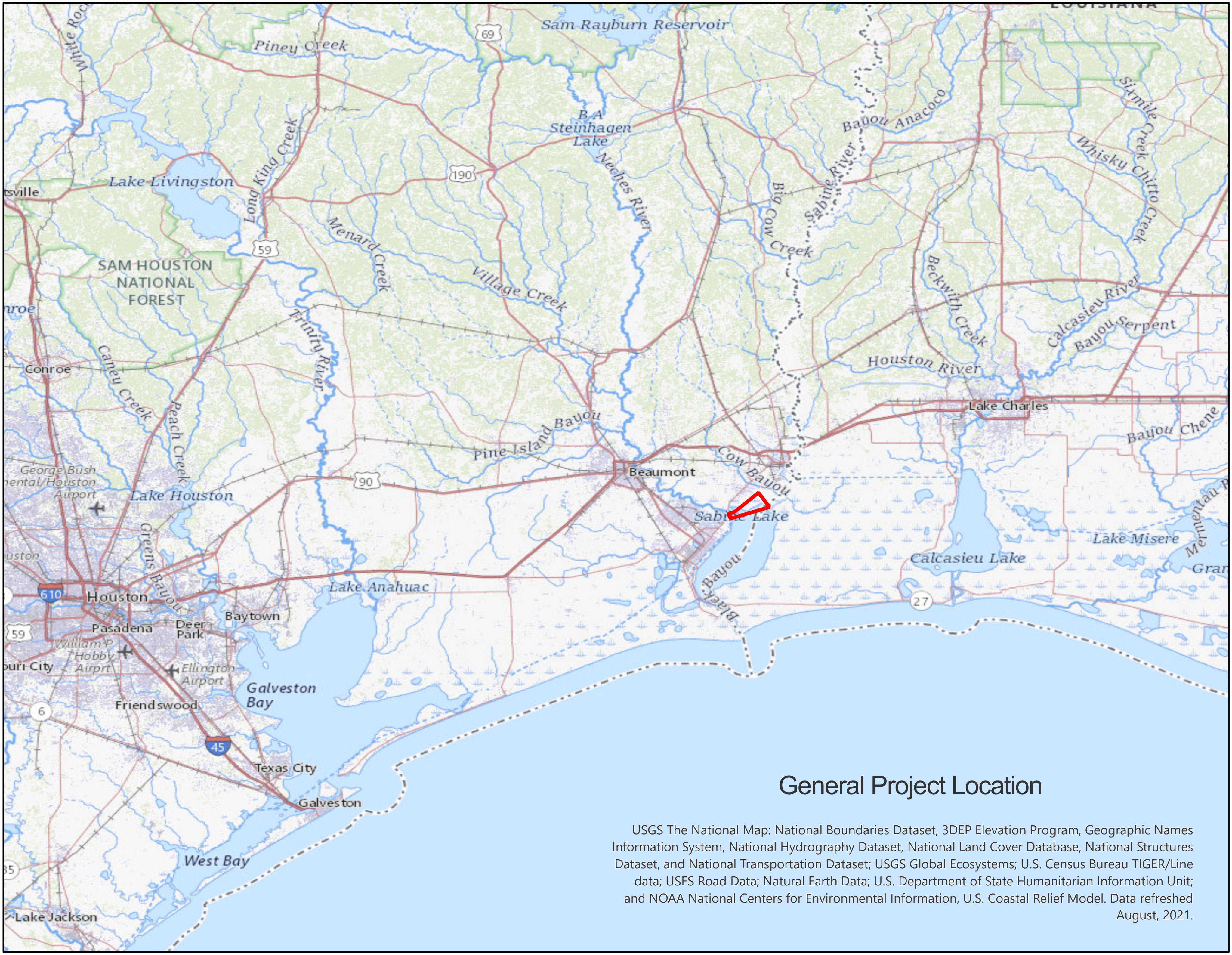

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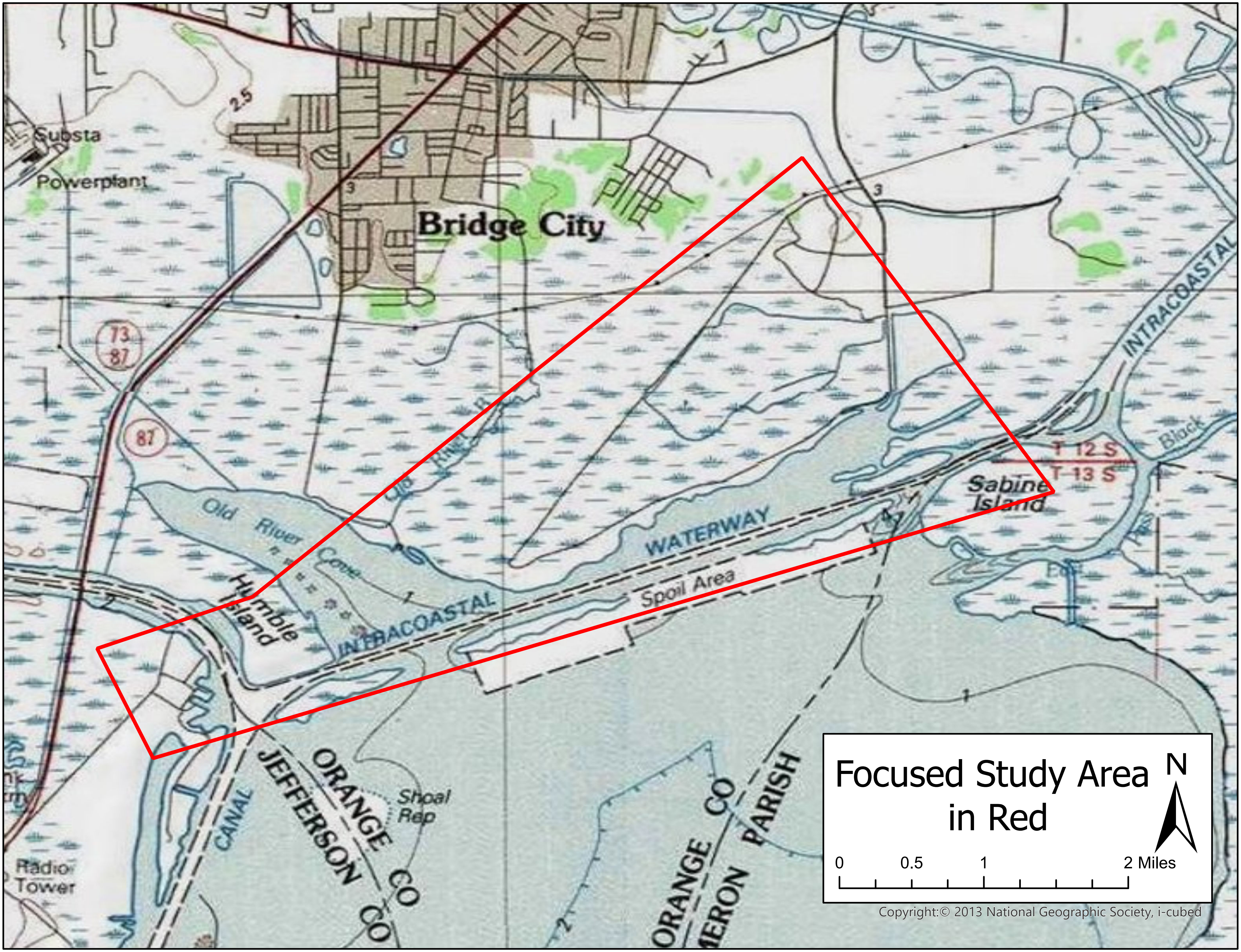
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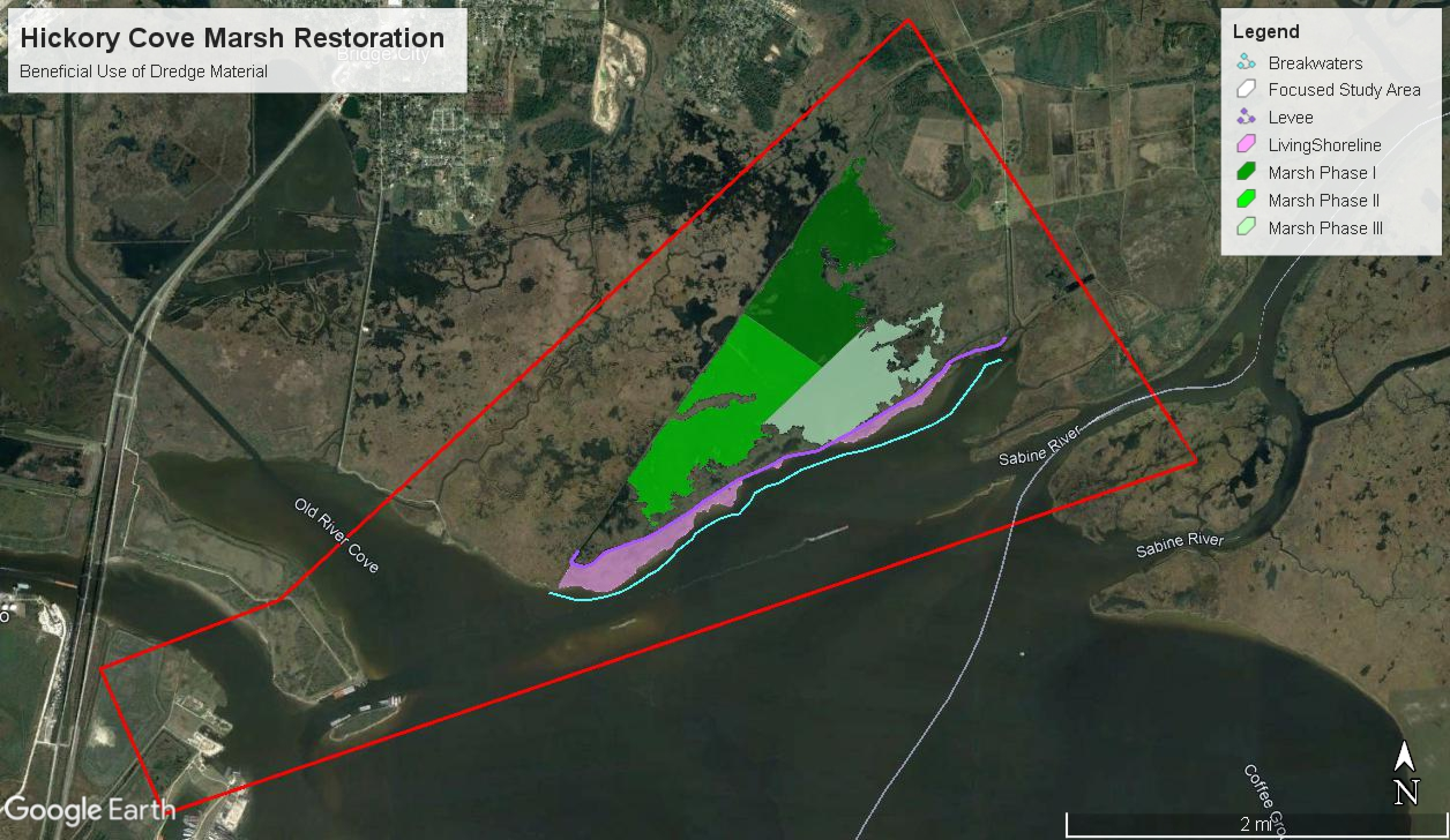
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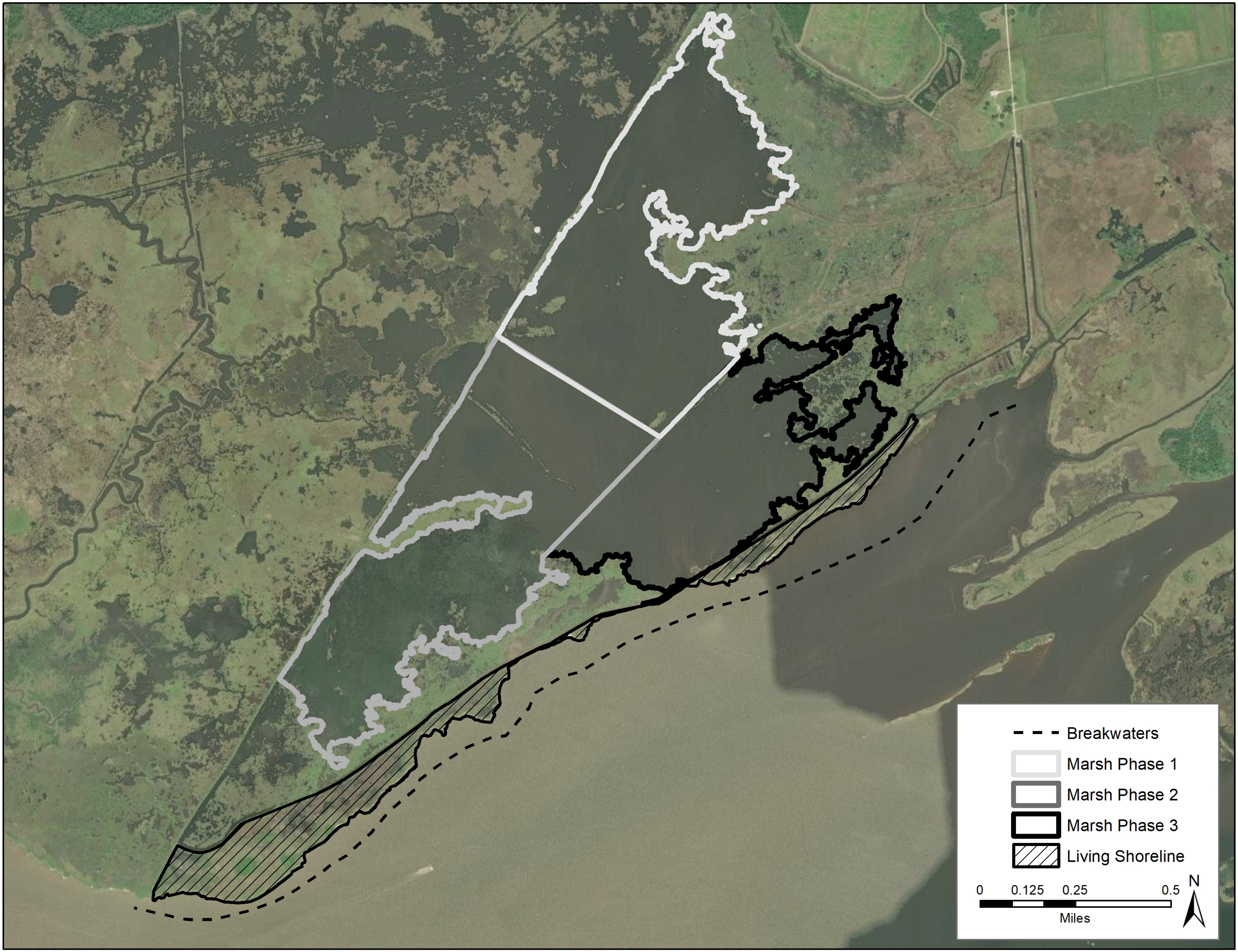
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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

September 27, 2021

Subject: Hickory Cove Marsh Restoration and Living Shoreline Project Coordination

Mr. Russell Martin
President
Tonkawa Tribe of Oklahoma
1 Rush Buffalo Road
Tonkawa, OK 74653

Dear Mr. Martin:

The U.S. Army Corps of Engineers (USACE), in partnership with the Orange County Navigation and Port District (non-federal sponsor for the project), is preparing a draft Integrated Feasibility Report and Environmental Assessment (DIFR-EA) for the Hickory Cove Marsh Restoration and Living Shoreline Project in Orange County, Texas, UTM 15N 421893E 3318528N. The study was authorized by Section 1122 of the Water Resources Development Act of 2016 which requires the USACE to establish a pilot program to carry out projects for the beneficial use of dredged material. The Hickory Cove Marsh Restoration and Living Shoreline Project was selected by the Office of the Assistant Secretary of the Army for Civil Works to be one of the pilot projects. This project includes the beneficial use of dredged maintenance material from the Sabine-Neches Waterway to restore approximately 650 acres of marsh within an existing 1200-acre impoundment and native plantings along 95 acres of adjacent coastline to create a living shoreline feature. The project also includes repairs to the existing containment levee and the installation of a rock breakwater adjacent to the shoreline to combat wave erosion (see enclosed maps). The marsh restoration is expected to require several dredge cycles to complete. The first dredge cycle is anticipated to begin in 2023 and will discharge 1.3 million cubic yards of maintenance dredged material to restore approximately 190 acres of marsh habitat.

Currently, the shoreline in the project area has eroded due to wave action and navigation traffic. Much of the shoreline has experienced significant loss, to the point that the containment levee surrounding the marsh has been breached. This has allowed estuary water to enter the marshes, where sediments are continually eroding and has converted approximately 80 percent of the project area to open water.

The study area was examined for any known historic properties using the Texas Historical Commission's (Atlas) database. This review found nine previous terrestrial cultural resource surveys and five maritime cultural resources surveys within the focused study area. The area for the proposed living shoreline has been surveyed in its

entirety; however, the areas proposed for the breakwater and the interior portions of the existing impoundment have not been previously surveyed.

Twenty-two previously recorded sites have been identified in the focused study area. Sixteen of those sites are within the living shoreline area that will be directly impacted by the project. Sites within the living shoreline area include: 41OR17, 41RO18, 41OR19, 41OR20, 41OR21, 41OR29, 41OR30, 41OR31, 41OR32, 41OR33, 41OR43, 41OR44, 41OR45, 41OR46, 41OR47, and 41OR48. Sites within the focused study area that will not be directly impacted include: 41OR41, 41OR75, 41OR79, 41JF18, 41JF19, and 41JF20. All locations within the focused study area are shell middens that have not been evaluated for the National Register of Historic Places (NRHP). Twenty sites were recorded in 1940 as many were being mined for the shell. Site 41OR33 was recorded in 1956 as it was actively being destroyed for shell mining. Site 41OR79 was recorded in 1973, and it was noted that a large portion of the site had been removed during dredging activities.

Five additional sites, including 41OR36, an unevaluated shell midden; 41OR73 an ineligible surface shell scatter; 41OR74, an unevaluated destroyed shell midden; 41OR77, an unevaluated shell midden; and 41JF17, an unevaluated shell midden, are located within 1-kilometer of the focused study area. No historic properties or districts listed on the NRHP or cemeteries are present within the focused study area or within 1-kilometer of the concentrated study area. Two Texas historical markers for the Rainbow Bridge (11509 and 10555, respectively) are located within 1-kilometer of the focused study area. The levee surrounding the marsh is less than 50 years old and is not eligible for consideration for the NRHP.

In 1973, the Texas Archaeological Survey conducted a cultural resources survey investigation which included the current project area and was conducted prior to the planned USACE placement of dredged material from the Sabine Neches Waterway. Access to the current project area for the survey was limited due to safety hazards from the high-water table, shallow standing water, and thick vegetation. The survey was limited to shorelines accessible by boat and aerial investigation by helicopter (see attached report). During the 1973 survey, none of the sites recorded between 1940 and 1956 could be accurately relocated and were instead lumped together into three locales. The three locales were described as either destroyed or extremely degraded. Destruction of the sites was mainly attributed to shell mining and continued erosion. Since the 1973 survey, dredged material was placed over the majority of the current project area, including where the remnants of all 16 shoreline sites were located.

Continuing shoreline erosion, subsidence, relative sea level change, and previous disturbances have caused the project area to degrade to the current state which is

approximately 80 percent open water. Given the current state of the project area and the determinations listed in the 1973 cultural resources survey for all of the previously recorded sites, the USACE has determined that No Historic Properties will be effected by the proposed undertaking. We request your concurrence with our determination that no historic properties are present and that the proposed action complies with Section 106 of the National Historic Preservation Act of 1966. A copy of the DIFR-EA for the Hickory Cove Marsh Restoration and Living Shoreline project will be provided to your office for review.

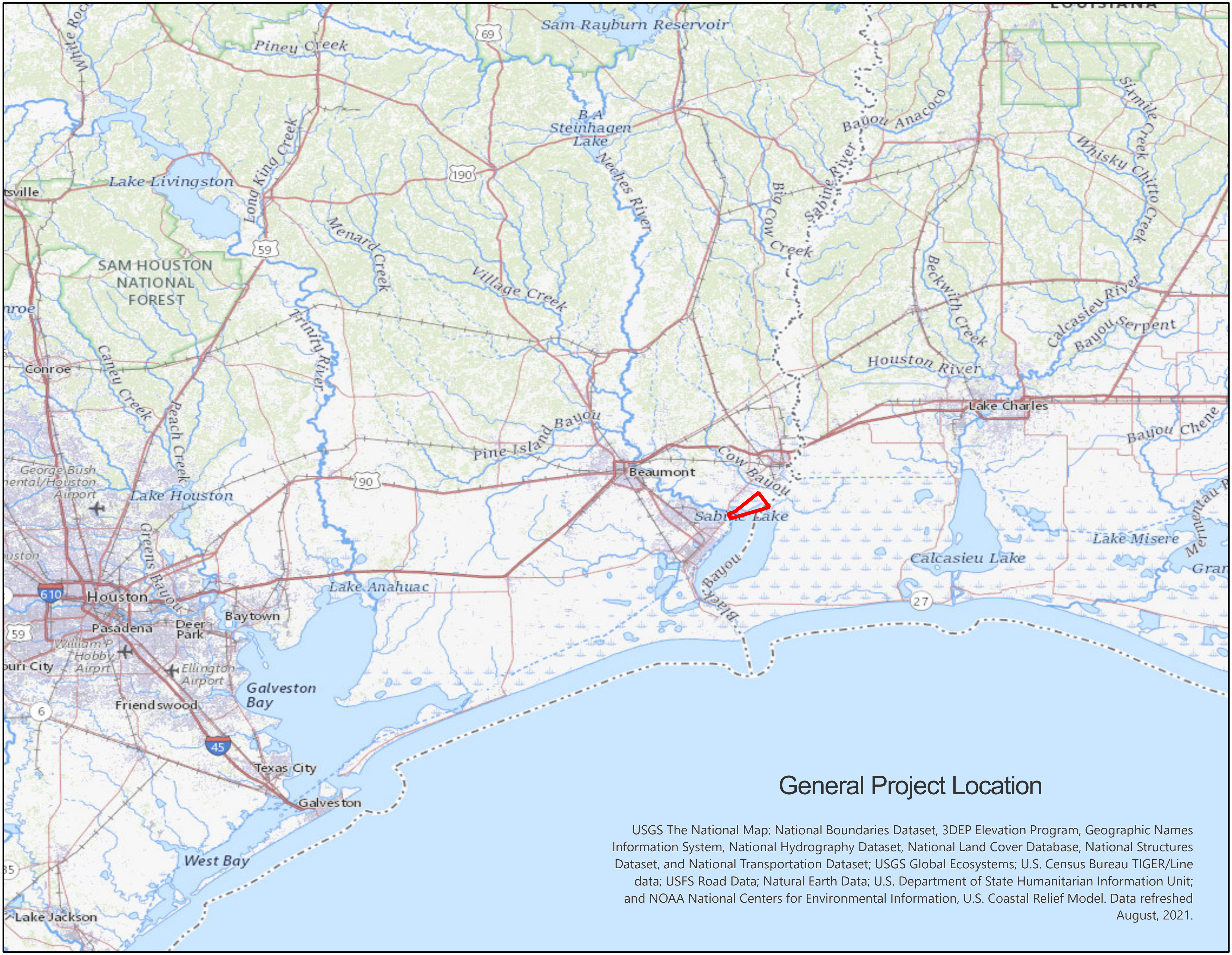
Thank you for your cooperation in this review process. If you have any questions concerning this project or need further assistance, please contact Jackie Rodgers, Archaeologist, Regional Environmental Planning Center at (918) 669-4964 or via email at Jacqueline.Rodgers@usace.army.mil. Your comments would be appreciated within 30 days of receipt of this letter.

Sincerely,

Amanda McGuire

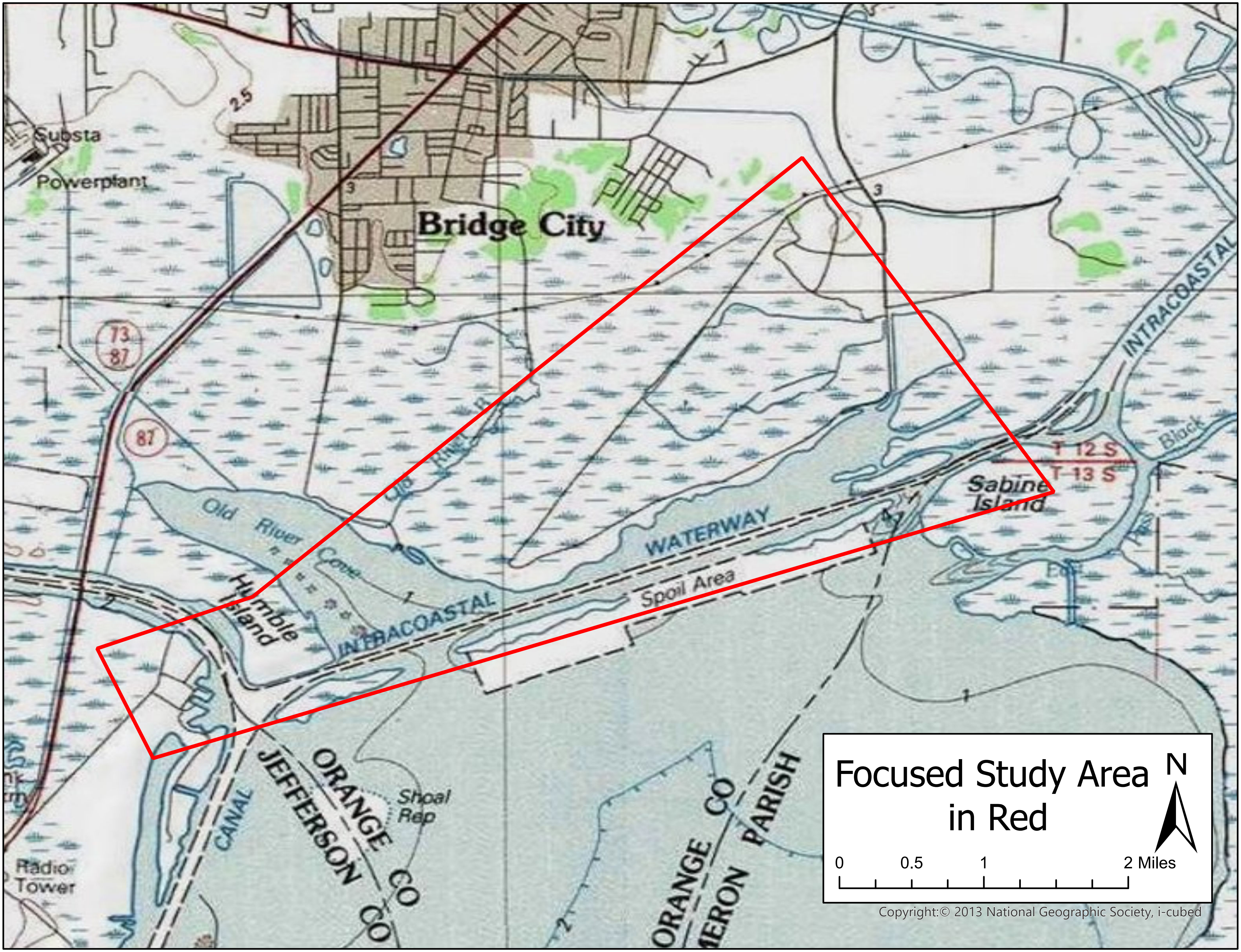
Amanda M. McGuire
Chief, Environmental Branch
Regional Planning and Environmental Center

Enclosures



General Project Location

USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed August, 2021.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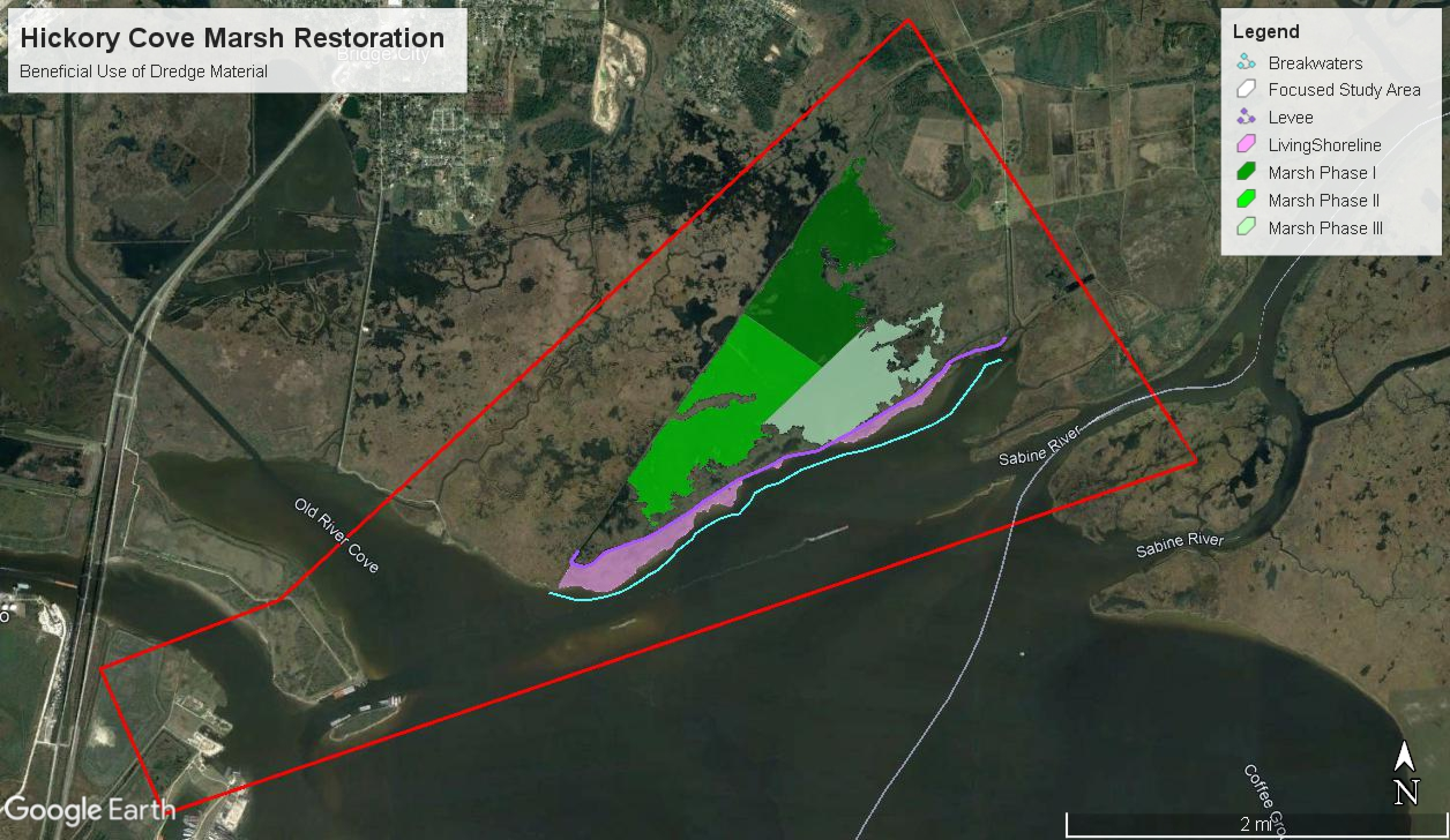

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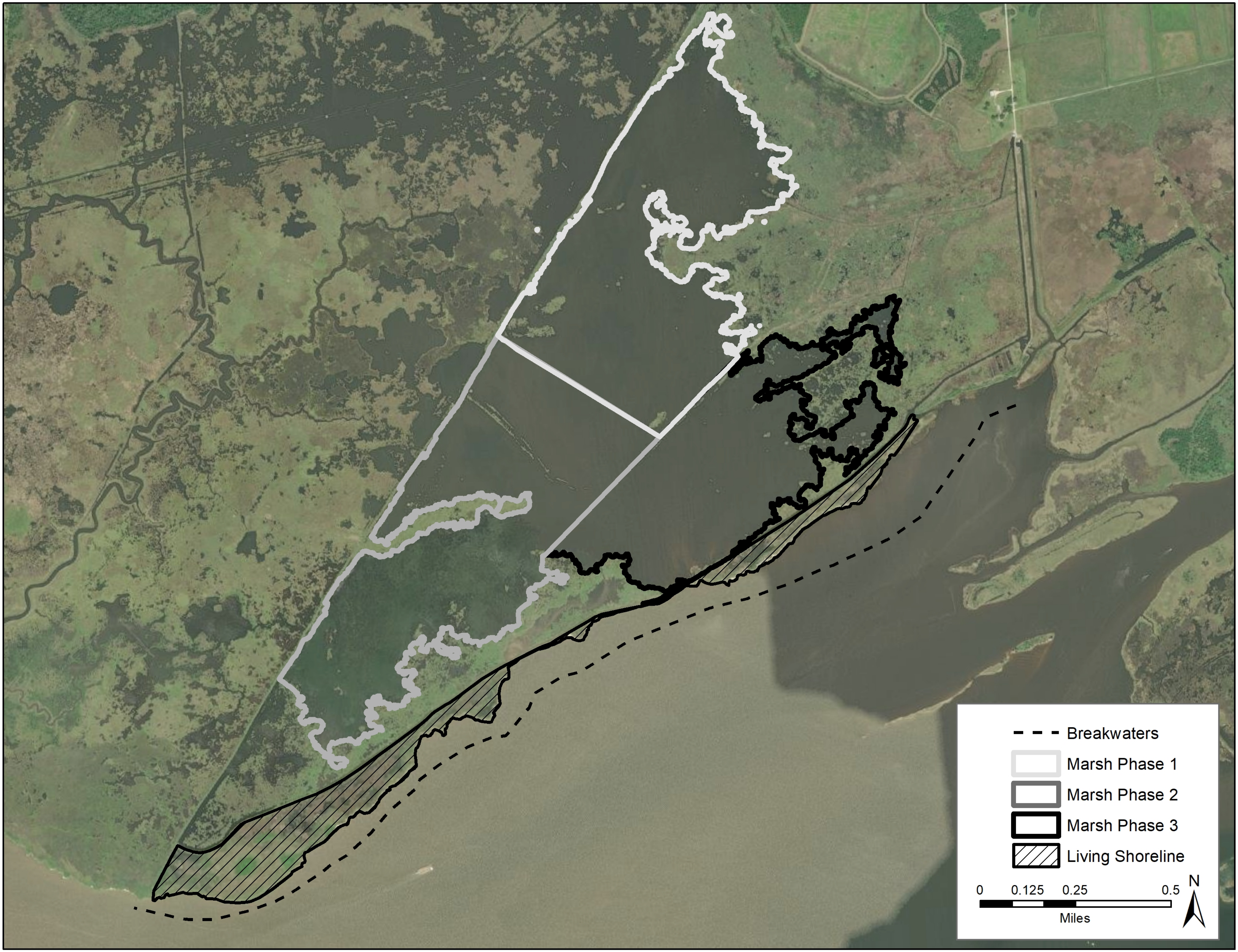

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US Army Corps
of Engineers ®
Galveston District

Appendix B-6

Ecological Modeling

for

WRDA Section 1122 Beneficial Use Pilot Project, Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas

November 2021

WRDA Section 1122 Beneficial Use Pilot Project, Beneficial Use Placement for Marsh Restoration Using Navigation Channel Sediments Hickory Cove Marsh, Bridge City, Texas

Ecological Modeling

Prepared by:

United States Army Corps of Engineers
Regional Planning and Environmental Center

November 2021

US Army Corps
of Engineers ®
Galveston District

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1.0 INTRODUCTION

This appendix provides documentation of the habitat evaluation and quantification process that was conducted for the project alternatives. Section 1122 of WRDA 2016 directed the Secretary of the Army to establish a pilot program consisting of 10 projects for the beneficial use of dredge material for specified purposes. The Hickory Cove Marsh Restoration and Living Shoreline Project was one of the selected pilot programs. The project is located in Bridge City, Orange County, Texas.

1.1 PROPOSED PROJECT

The Orange County Navigation and Port District (OCNPD) in collaboration with Ducks Unlimited submitted the project proposal which sought to utilize 1.5 million cubic yards of dredge material to restore 1,200 acres of marsh and establish a living shoreline adjacent and near the Sabine River Channel in Orange County, Texas. The proposal states that the section of the channel that would be utilized by this project is authorized to a dredge depth of -31 feet, but continuous shoaling and heavy deposition associated with storms like Hurricane Harvey have reduced the channel depth to -23 feet. The proposal also states that the beneficial use site would have a 3 million cubic yard capacity which could accept the 1.5 million cubic yards of material to meet the current maintenance requirement to re-establish the authorized channel depth and provide capacity for several future dredge cycles.

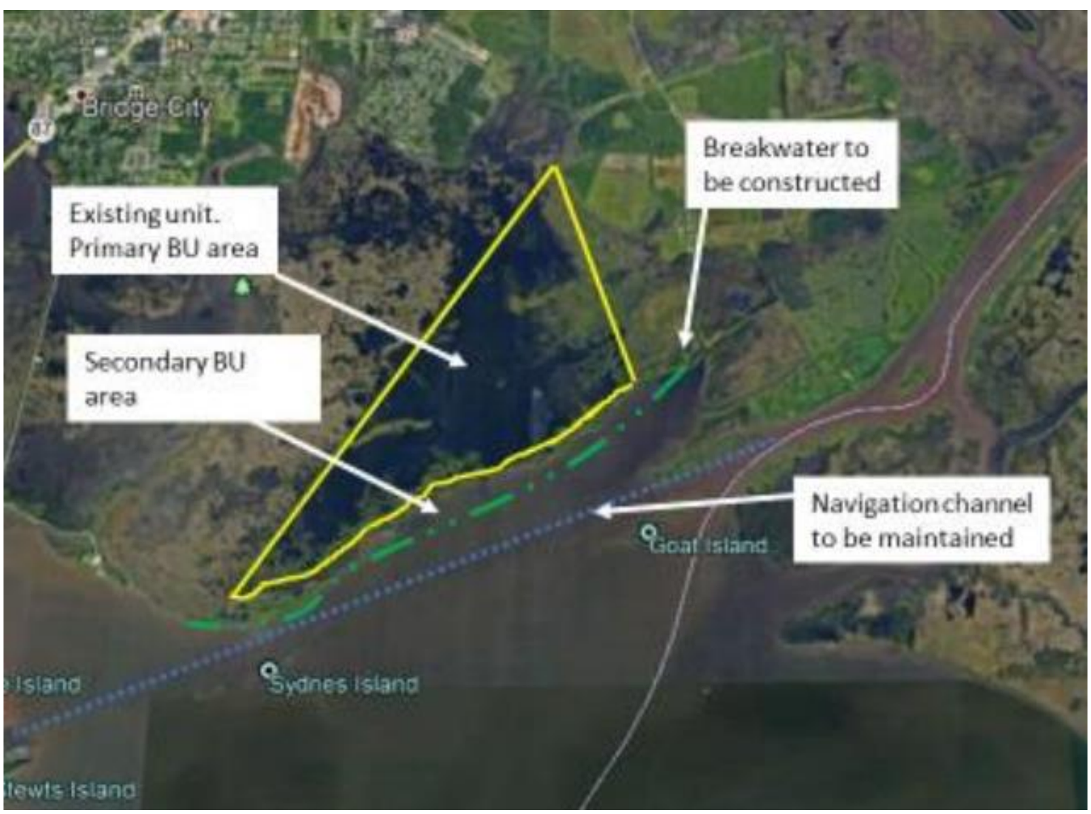

Figure 1-1. Map of project site taken from Proposal submitted by OCNPD.

1.2 CONSIDERATION FOR THE DEVELOPMENT OF ALTERNATIVES

To develop alternatives, the Product Delivery Team (PDT) evaluated the components of the proposal and information from the ongoing USACE work near the project location. The Programmatic Environmental Assessment for Selection of Recommended Projects (PEA 2018) states that the project will restore emergent marsh habitat important to migratory and resident waterfowl and provides an opportunity to remove sedimentation resulting from Hurricane Harvey, where maintenance dredging is currently not preformed due to a lack of placement areas. The proposal included the following project components: repairing an existing levee, installing approximately two miles of breakwater to create a living shoreline and stabilize the levee, site preparation (*e.g.* creating training berms), placing 1.5 million cubic yards of dredge material within the primary beneficial use area, and planting the site with native emergent plant species. The study team evaluated the proposal and came to several conclusions:

- **Proposed dredge depth and available sediment estimates:** Shoaling upstream from the project presented policy and funding challenges to allow dredging to the authorized depth of -31 feet. Recent surveys were consulted, and several channel depths were considered for evaluation with each scenario having an adjusted sediment volume available for marsh restoration. The depths and corresponding quantities are listed under the alternative descriptions below.

- **Reference site selection:** The Interagency Coordination Team (ICT) recommended using a reference location to identify target parameters for project success. General target parameters for marsh restoration projects on the Gulf Coast include target range for substrate elevation, plant species composition, and landscape composition (percentages of open water, marsh, or higher areas). The PDT the reference location recommended by the ICT, which is a completed marsh restoration project at the Lower Neches Wildlife Management Area (WMA), Old River Unit (Figure 1-2). The reference site is near the project area, used dredge material, to restore a similar amount of marsh as the proposal, and is considered a highly successful.

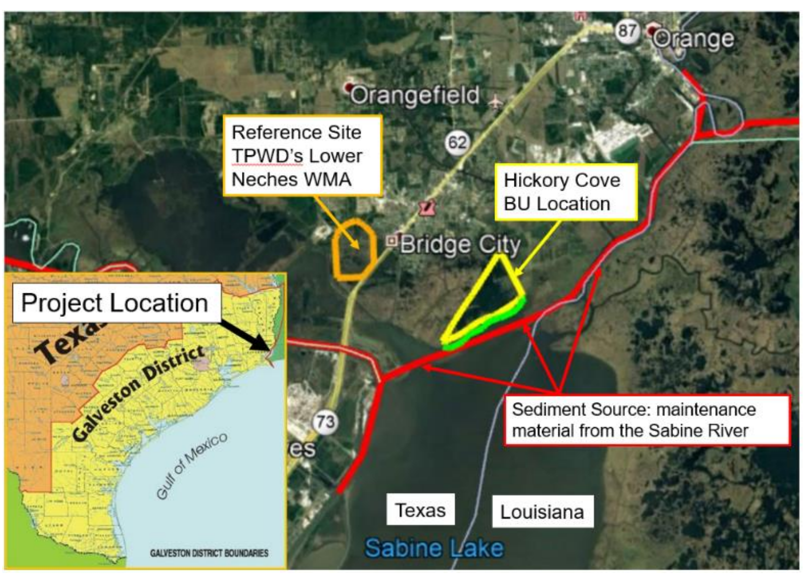

Figure 1-2. Map of Reference Site and Project Area.

- **Target elevations for marsh restoration:** The PDT reviewed information provided by the ICT and data gathered during the site visit to reference site. For the living shoreline portion of the project, *Spartina alterniflora* (smooth cordgrass) was selected as the target plant species and has an optimal substrate elevation between 0.0- to 0.5-foot North American Vertical Datum of 1988 (NAVD 88) in this region. For the portion of the project located in the impoundment, *Spartina patens* (marsh hay cordgrass) was selected as the target plant species and has an optimal substrate elevation between 0.5- to 1.2-foot NAVD 88 in this region. The Texas Parks and Wildlife Department (TPWD) provided the PDT with their analysis of the settlement rates of the beneficial use materials observed at the Lower Neches WMA, Old River Unit to help inform project design.

- **Landscape composition:** The ICT did not recommend additional considerations for landscape composition because the experience with beneficial use sites is that remnant ponds and channels will re-establish as the dredge material settles.

- **Existing Conditions:** During the site visit, the PDT conducted an elevation survey, and the boundaries of existing marsh were identified. Approximately 678 acres of open water are available for marsh restoration within the impoundment. There were several breaches in the observed in the containment levee surrounding the impoundment which allowed tidal flow into the interior portions of the impoundment. The open water areas within the impoundment were shallow (2-foot deep or less) and unvegetated. The water was highly turbid on the day of the site visit. Figure 1-3 is representative of the open water areas within the impoundment proposed for beneficial use. Section 3.1 describes the existing condition in more detail.

Figure 1-3. Picture inside the Hickory Impoundment taken on November 21, 2019.

1.2.1 Modeled Alternatives

The following alternatives were analyzed and modeled to determine the potential ecological lift or benefits of implementing the action.

- **No Action Alternative**
  - Under this scenario, no maintenance dredging or beneficial use would occur. The levee would not be repaired, and the living shoreline would not be constructed. Issues with fluctuating salinities, tidal forces, and relative sea level change would continue to convert marsh habitat to open water.
- **Alternative 1a**
  - Under this scenario the levee would be repaired, and 68 acres of palustrine emergent wetlands would be restored using approximately 500,000 cubic yards (cy) of dredge material to create suitable substrate elevations. The restored marsh would be planted with marsh hay cordgrass. The repaired levee is assumed to reduce the influence of relative sea level change (RSLC), salinity fluctuations, and tidal forces on existing and restored interior marshes (Figure 1-4).
  - This scenario does not include the breakwater in front of the repaired levee.
- **Alternative 1b**
  - Under this scenario the levee would be repaired, 126 acres of palustrine emergent wetlands would be restored using approximately 900,000 cy of dredge, and the unit would be planted with marsh hay cordgrass (Figure 1-4)
  - The assumptions applied to Alternative 1a also apply to this scenario.
- **Alternative 1c**
  - Under this scenario the levee would be repaired, 190 acres of palustrine emergent wetlands would be restored using approximately 1.3 million cy of dredge, and the unit would be planted with marsh hay cordgrass. (Figure 1-4)
  - The assumptions applied to Alternative 1a also apply to this scenario.

Figure 1-4. Alternatives 1a, 1b, and 1c

- **Alternative 2**
  - Under this scenario the levee would be repaired, 1.3 million cy of material would be used to restore 190 acres of palustrine emergent wetlands, and the unit would be planted with marsh hay cordgrass.
  - Alternative 2 also includes the construction of a breakwater, which is assumed to protect the repaired levee from erosion for the life of the project. Similar structures in the area and throughout Texas and Louisiana have protected shorelines and enhanced resilience to coastal storms (Figure 1-5

Figure 1-5. Alternative 2

- **Alternative 3**
  - Under this scenario the levee would be repaired, 1.3 million cy of material would be used to restore 190 acres of palustrine emergent wetlands, the unit would be planted with marsh hay cordgrass, and the breakwater would be constructed.
  - Alternative 3 also includes the creation of a 95-acre living shoreline between the repaired levee toe and the breakwater. Invasive plant species, primarily Chinese tallow (*Triadica sebifera*) would be removed from the levee and smooth cordgrass would be planted (Figure 1-6).

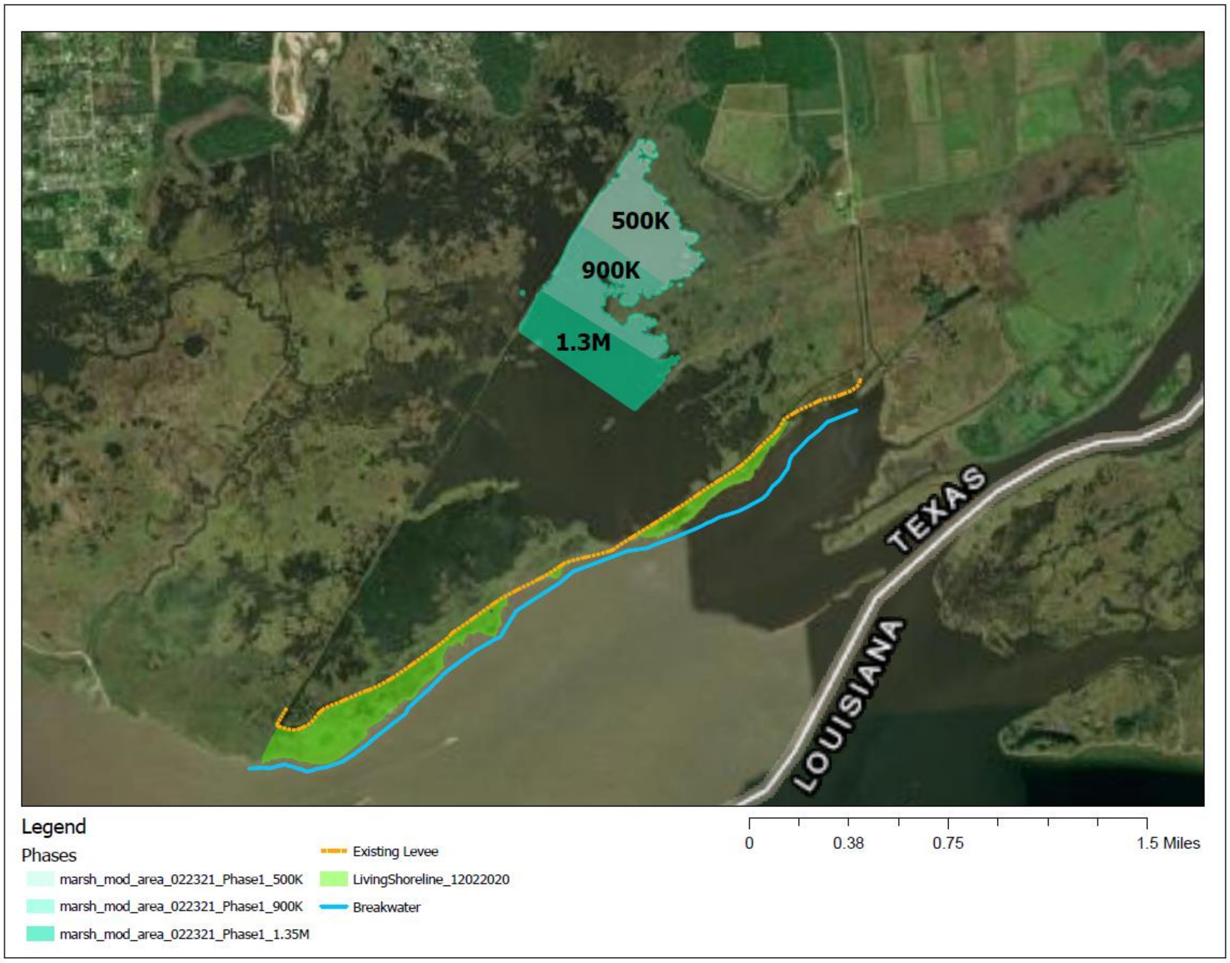

Figure 1-6. Alternative 3

2.0 ECOLOGICAL MODELING APPROACH

An Interagency Team comprised of State and Federal resource agencies was invited to participate in planning the restoration activities and to provide input on the ecological modeling strategies for the project. The team agreed that Habitat Evaluation Procedures (HEP) modeling using an USACE-certified species' model would be the best approach for the study. Several USACE-certified species' models were considered based on the range of each modeled species, existing and future cover types, and specific habitat requirements described by the models. Specifically, ecological models for the mottled duck (*Anus fulvigula*), Atlantic croaker (*Micropogonias undulatus*), Gulf Menhaden (*Brevoortia patronus*), and a general dabbling duck model were considered. The Interagency Team concurred with using the mottled duck model because several other ecological restoration projects in the region are focusing on restoring habitat that will aid in the recovery of the species (communications with TPWD, DU, and the Gulf Coast Joint Venture). Assumptions regarding the ecological modeling, the restoration measures, and stressors that led to the existing conditions at the project site were also discussed and documented by the team.

2.1 HABITAT EVALUATION PROCEDURE (HEP)

HEP involves 1) defining the study area, 2) delineating habitats (i.e. cover types) within the study area, 3) selecting HEP a model or models and/or evaluation species; and 4) characterizing the study area based on the results of the HEP. In this instance it also involved the evaluation of a nearby reference site.

HEP was developed by the US Fish and Wildlife Service (USFWS) in order to quantify the impacts of habitat changes resulting from land or water development projects (USFWS 1980). HEP is based on suitability models that provide a quantitative description of the habitat requirements for a species or group of species. HEP models use measurements of appropriate variables to rate the habitat on a scale from 0.0 (unsuitable) to 1.0 (optimal).

Habitat quality is estimated through the use of species models developed specifically for each habitat type(s). Each model consists of a 1) list of variables that are considered important in characterizing fish and wildlife habitat, 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality and different variable values, and 3) a mathematical formula that combines the Suitability Index for each variable into a single value for habitat quality. The single value is referred to as the Habitat Suitability Index (HSI).

The Suitability Index graph is a graphic representation of how fish and wildlife habitat quality or "suitability" of a given habitat type is predicted to change as values of the given variable change. It also allows the model user to numerically describe, though the Suitability Index, the habitat quality of an area for any variable value. The Suitability Index ranges from 0 to 1.0, with 1.0 representing optimal condition for the variable in question.

After a Suitability Index has been developed, a mathematical formula that combines all Suitability Indices into a single HSI value is constructed. Because the Suitability Indices range from 0 to 1.0 the HSI also ranges from 0 to 1.0 and is a numerical representation of the overall or "composite" habitat quality of the particular habitat being evaluated. The HSI formula defines the aggregation of Suitability Indices in a manner that is unique to each species depending on how the formula is constructed.

2.1.1.1 Relative Sea Level Change

The USACE guidance (USACE 2013, USACE 2014) specifies the procedures for incorporating climate change and RSLC into planning studies and environmental/engineering design projects. The proposed projects must consider measures that are formulated and evaluated for a wide range of possible future rates of RSLC. The guidance requires that alternatives be evaluated using either "low," "intermediate," or "high" rates of future RSLC, as defined below:

- **Low** – Low rates of local sea level change are determined by identifying the historical rate of local mean sea level change, which are best determined by local tide records.
- **Intermediate** – Intermediate rates of local sea level change are estimated using the modified Natural Research Council (NRC) Curve I, which is corrected for the local rate of vertical land movement.
- **High** – High rates of local sea level change are estimated using the modified NRC Curve III, which is corrected for the local rate of vertical land movement.

2.2 MOTTLED DUCK HSI

2.2.1 Variable Descriptions

- **V_1 – Percentage of unsubmerged substrate covered by rushes, bulrushes, or cattails.** Optimal nesting habitat is dominated by grasses and similarly structured vegetation.
- **V_2 – Percentage canopy cover of trees and shrubs on unsubmerged substrate.** Quality of nesting habitat decreases with increasing cover of woody vegetation; habitat with 30 percent (%) woody vegetation canopy cover is suitable.
- **V_3 – Structure of herbaceous vegetation (excluding rushes, bulrushes, and cattails) on unsubmerged substrate.** Nesting habitat quality is related to height and density of grasses and similarly structured vegetation excluding bulrushes, rushes, and cattails.
    - Class 1. Not growing in clumps
    - Class 2. Growing in clumps; 0.25 to 0.50 meters (m) (0.82 to 1.64 feet [ft]) tall and or providing overhead cover to 1% to 15%.
    - Class 3. Growing in clumps; 0.50 to 0.75 m (1.64 to 2.46 ft) tall and or providing overhead cover to 16% to 79%.
    - Class 4. Growing in clumps with overlapping tops; >0.75 m (2.46 ft) tall and/or providing > 80% overhead cover

- Note: Calculate the percentage of total unsubmerged substrate area in each structure class (1, 2, 3, and 4). This percentage is expressed as a decimal, becomes the weighting factor (W) for each class. Calculate SI_{V_3} as follows:

$$SI_{V_3} = 0.1W_1 + 0.3W_2 + 0.6W_3 + 1.0W_4$$

- **V_4 – Percentage of continually submerged covered by woody or herbaceous emergent vegetation.** Optimal brood-rearing habitat is a submersed substrate supporting growth of emergent vegetation over 50% of its area.
- **V_5 – Structure of woody or herbaceous emergent vegetation growing in continually submerged substrate.** Quality of emergent vegetation as escape cover is related to its height and density.
  - Class 1. < 0.3 m (< 1.0 ft) tall or too dense to allow passage of ducklings.
  - Class 2. > 0.3 m (> 1.0 ft) growing in mats or in sparse stands.
  - Class 3. 0.3 to 1.0 m (1.0 to 3.3 ft) tall and sufficiently dense to make passage difficult for a large predator (*e.g.* racoon).
  - Class 4. > 1.0 ft ((> 3.3 ft) tall and sufficiently dense to be almost impenetrable to a large predator but with openings and passageways for escape of ducklings.
  - Note: Calculate the percentage of total submerged substrate area in each structure class (1, 2, 3, 4). This percentage, expressed as a decimal, becomes the weighting factor (W) for each class. Calculate SI_{V_5} as follows:

$$SI_{V_5} = 0.0W_1 + 0.3W_2 + 0.6W_3 + 1.0W_4$$

- **V_6 – Percentage of Study area that is land (substrate not submerged and not supporting growth of rushes, bulrushes, or cattails).** Optimal reproductive habitat for mottled ducks consists of equal amounts of nesting and brood-rearing habitats.
- **V_7 – Percentage of continually submerged substrates with water depth less than 30.0 centimeters (cm) (11.8 inches) at low mean tide.** Depth of water is related to feeding efficiency of mottled duck hens and broods.
- **V_8 – Disturbance Level.** Irregular disturbance is detrimental to nesting mottled duck hens and hens with broods.
  - Class 1. Extreme: support heavy grazing or may be located within 300 m of exceedingly noisy or obtrusive industry, or other intense disturbances, such as runways. Free-ranging dogs, marsh-buggies, and motorcycles may be present.
  - Class 2. Moderate: within 25 m of roads, or within 300 m of light to moderate levels of disturbance, such as occupied dwellings, business, or light industry. Disturbances in the immediate vicinity should not be extreme, although infrequent but intense disturbances (marsh-buggies and motorcycles) may occur. Grazing should be light or absent from March to May.
  - Class 3. Minimal: at least 25 m (82 ft) from maintained roads or heavily used waterways, or at least 300 m (984 ft) from any place or structure regularly

occupied by people or dogs, or that emit machinery-caused noise at 300 m). Areas of minimal disturbance should not be subject to infrequent abrupt disturbances, such as airboats and off-road vehicles.

- Class 4. None

2.2.2 HSI Calculations:

- Nesting Hen Cover (NHC) = $(SI_{V_1} \times SI_{V_2} \times SI_{V_3})^{1/3}$
- Hen with Brood Cover (HBC) = $(SI_{V_4} \times SI_{V_5})^{1/2}$
- Cover Structure (CS) = NHC or HBC, whichever is lower
- Cover Ratio (CR) = SI_{V_6}
- Reproductive Cover Life Requisite (C) = $(CS^2 \times CR)^{1/3}$
- Food life requisite (F) = SI_{V_7}
- Other life Requisite (O) = SI_{V_8}

HSI = C, F, or O, whichever is lowest.

2.3 CALCULATION OF AVERAGE ANNUAL HABITAT UNITS

Individual species HSI scores were generated for each measure location using the species-specific spreadsheet calculators. The HSI scores were then multiplied by the acreages to calculate the Habitat Units (HUs). HUs represent a numerical combination of quality (i.e. Habitat Suitability Index) and quantity (acres) existing at any given point in time.

HUs represent a single point in time; however, the impacts of any of the proposed actions would occur over the entire planning horizon (50 years). To account for the value of change over time, when HSI scores are not available for each year of analysis, the cumulative HUs are calculated using a formula that requires only the target year (TY) and the area estimates (USFWS 1980). The following formula was used:

$$\int_0^T HU\,dt = (T_2 - T_1)\left[\left(\frac{A_1H_1 + A_2H_2}{3}\right) + \left(\frac{A_2H_1 + A_1H_2}{6}\right)\right]$$

Where:

$$\int_0^T HU\,dt = Cumulative\,HUs$$

T1= first target year of time interval

T2 = last target year of time interval

A1 = area of available habitat at beginning of time interval

A2= area of available habitat as the end of time interval

H1 = Habitat Suitability Index at the beginning of time interval

H2 = Habitat Suitability Index at the end of time interval

3 and 6 = constants derived from integration of HSI x Area for the interval between any two target years

This formula was developed to precisely calculate cumulative HUs when either HSI or area or both change over a time interval, which is common when dealing with the unevenness found in nature. HU gains or losses are annualized by summing the cumulative HUs calculated using the above equation across all target years in the period of analysis and dividing the total (cumulative HUs) by the number of years in the planning horizon (i.e. 50 years). This calculation results in the Average Annual Habitat Units (AAHUs) (USFWS 1980).

The impact of a project can be quantified by subtracting the FWP scenarios benefits/impacts from the FWOP benefits/impacts. The difference in AAHUs between the FWOP and the FWP represents the net impact attributable to the project in terms of habitat quantity and quality, where a positive number results in net benefits and a negative number results in net loss.

3.0 DATA AND ASSUMPTIONS

This section describes the methodology used to determine baseline, FWOP, and FWP conditions for the project area.

3.1 EXISTING CONDITIONS

The project area for this project includes a 1,200-acre, impoundment, known as the Hawk Club and a portion of Hickory Cove adjacent to the southeast boundary of the Hawk Club (Figure 1-1). The project area is north of and adjacent to Sabine Lake, between the confluences of both the Neches River and the Sabine River with Sabine Lake. Due to the proximity of the site to these riverine inputs and the Gulf of Mexico, this area is subject to drastic swings in salinity. Additionally, the tidal forces, river currents, boat wakes, and fetch from the prevailing southeast winds have caused extensive shoreline erosion in the region (Bureau of Economic Geology [BEG] 2017).

The primary BU placement area is approximately 1,200 acres in size and is bounded by a levee along the southeast side which has several breaches that allow for tidal exchange. As recently as 2005, the impoundment was comprised of palustrine emergent habitat with shallow ponds. Recent coastal storms like Hurricane Rita (2005), Hurricane Humberto (2007), Tropical Storm Eduardo (2008), Hurricane Gustav (2008), Hurricane Ike (2008), Hurricane Harvey (2018), and Hurricane Laura (2020), accelerated shoreline erosion causing repeated levee failures. The levee failures correspond with conversion of palustrine marsh habitat to estuarine open water habitat.

Presumably the habitat within the levee would have resembled adjacent palustrine habitat with dominant *S. patens* growing in thick clumps. Tremblay and Calnan (2009) conducted a regional analysis of wetland and aquatic habitat trends and report that the region containing the project area experienced a 58% loss of palustrine marsh habitat between 1956 and 2004 and that the majority was converted to estuarine open water habitat. The researchers (Tremblay and Calnan 2009) speculate that the shift in habitat was likely due to a combination of factors including: presence of fault lines, oil and gas industry caused subsidence, sea level rise, erosion, channelization, and canal construction.

3.1.1 Cover Type Mapping

The HEP model allows a numeric comparison of baseline conditions to each future condition and provides a combined quantitative and qualitative estimate of project-related benefits or impacts on ecosystem resources. To quantify the applicable habitat conditions within each project site, the HEP process requires that the cover types within each project footprint be quantified in terms of acres (quantity) and variables (quality) per each corresponding HSI model. The process of quantifying acres, referred to as “cover typing,” allows the user to define the differences between vegetative cover types and clearly delineate these distinctions on a map.

USGS data (Enwright et al. 2015), aerial imagery (Google Earth), and elevation data were used to evaluate and identify cover types within the project footprint and areas indirectly affected beyond the footprint. Other land cover datasets (such as USFWS National Wetland Inventory

[NWI], 2010 National Agriculture Imagery, and TPWD land cover) were considered for evaluation. However, it was determined by the ICT that the USGS land cover datasets would be most applicable because there are identified discrepancies in the other datasets that do not accurately reflect the existing conditions.

Based on the analysis, it was determined that 629 acres of existing marsh is present within the project boundaries and 856 acres (677 acres within and 180 acres outside the restoration units) is considered open water (Figure 3-1).

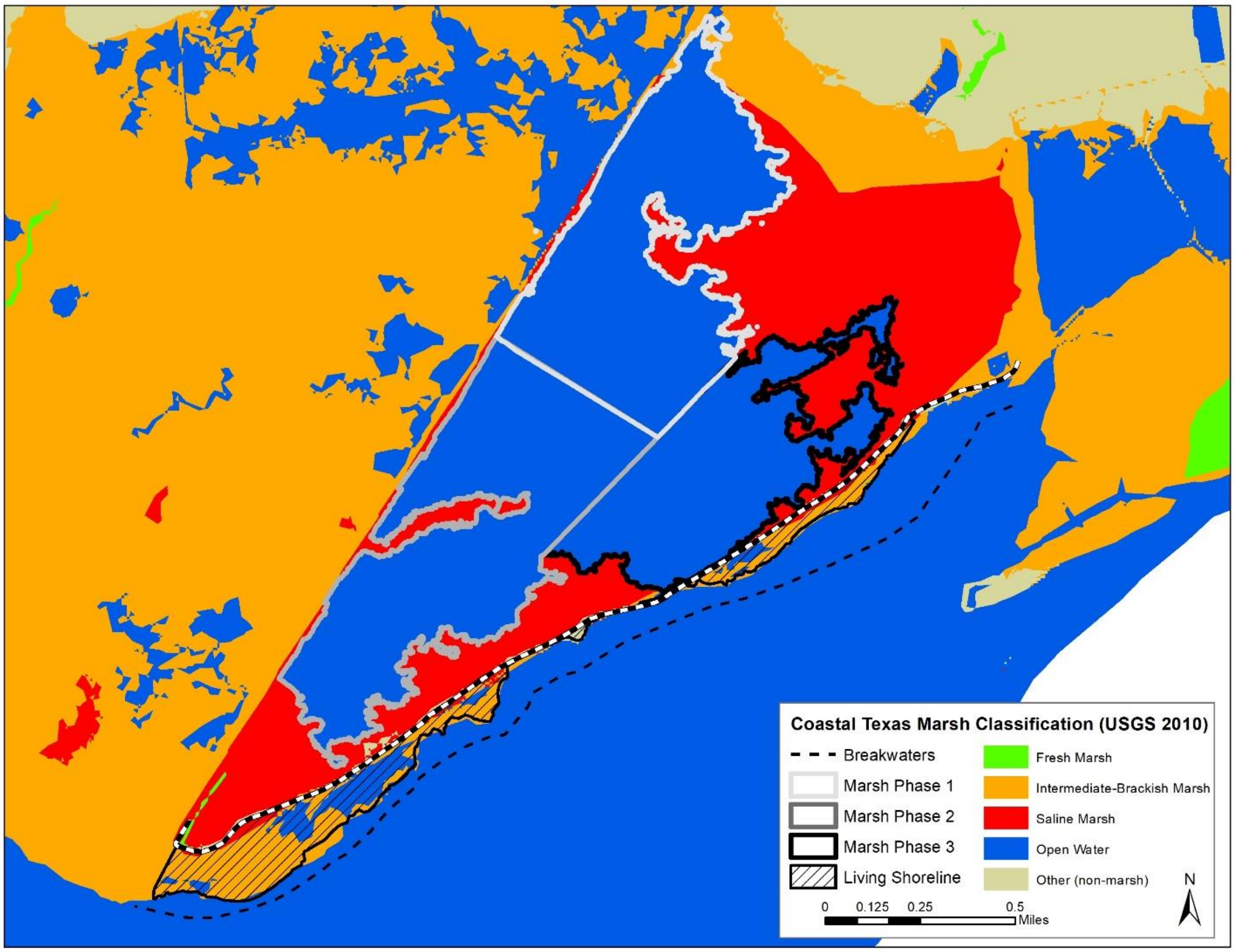

Figure 3-1. Existing habitat types within the project direct and indirect impact boundaries

3.1.2 Habitat Suitability

A site visit was conducted on November 21, 2019 by two USACE Biologists, three TPWD Biologists, and two USACE Geospatial Analysists who all contributed to defining the variable values of the Mottled Duck HSI for each data point. Elevation data and sample points were taken using the Mottled Duck HSI protocols (Table 3-3Table 3-1 and Figure 3-2). In the existing open water areas (Datapoint 3 and 4), the HSI score was 0.0, while in the existing marsh (Datapoint 1 and 2) had HSI scores of 0.37 and 0.32, respectively. For the FWOP conditions, existing marsh was assumed to have an average HSI score of 0.35. Attachment A provides the variable data and calculations.

Table 3-1. Elevation Data, Coordinates, and General Information about the Data Points at the Project Site (Hickory Cove Marsh).

	Hickory Cove Datapoint 1	**Hickory Cove Datapoint 2**	**Hickory Cove Datapoint 3**	**Hickory Cove Datapoint 4**
Coordinates:	29.9951 -93.8152	29.9929 -93.8124	29.9956 -93.8148	29.9973 -93.8109
Elevation NAVD88 (ft)	0.4	1.0	-1.9	-0.5
Location	On the edge of existing marsh	On the edge of existing marsh	Open water	Open water
Field notes	Location near levee breach	Location on north edge of narrow marsh peninsula	No SAV, located on the east side of the project site	No SAV, located on the west side of the project site

Figure 3-2. Ecological Modeling Sample Locations in the Project Area.

3.2 FUTURE WITHOUT PROJECT (FWOP)

This scenario is synonymous with the without project alternative. Under the FWOP, RSLC and continued breaching of the levee influence future habitat types.

3.2.1 Cover Type Mapping

The National Oceanic and Atmospheric Administration (NOAA) Coastal Change Atlas Program (C-CAP) 2010 and Marsh Migration land cover datasets (NOAA, 2017b; pers. com. N. Herold [NOAA], 2017) were used to project future habitat cover types with RSLC. The ICT determined that the C-CAP data would be most acceptable for future projections because it provides future conditions that incorporate migration of plant communities due to RSLC and allow for consistency and repeatability of the model evaluations (NOAA 2017a, 2017c).

The data for the C-CAP/Marsh Migration is based on the NOAA RSLC curves which is slightly more aggressive that the USACE curves. In order to cross-walk the NOAA RSLC curves to the USACE RSLC curves, target years were selected to correspond to 0.5-foot changes in sea level as identified using the USACE intermediate curve for the project period of analysis (2023-2073). The year 2075 was assumed to be similar and close enough in time to be representative of conditions anticipated in 2073, the end of the 50-year period of analysis. Table 3-2 shows the predicted rate of marsh habitat conversion to open water that was developed using data output from NOAA's marsh migration viewer geospatial tool (Figure 3-3).

Table 3-2. Relative Sea Leave Change predictions using the USACE Intermediate Curve and the NOAA Marsh Migration Viewer.

NOAA Elevation (MHHW)	Correlated USACE Int Curve elevation (MHHW)	Corresponding year	Target Year (Predicted start 2023)	Percent Marsh Remaining	Area Marsh Remaining (acres)
0.0	1.30	2023	0	100%	629
+0.5	1.79	2042	19	25%	157
+1.0	2.31	2060	37	15%	94
+1.5	2.79	2075	52*	2%	12.58
+2.0	3.31	2090	67*	0%	0
*Beyond 50-year planning horizon					

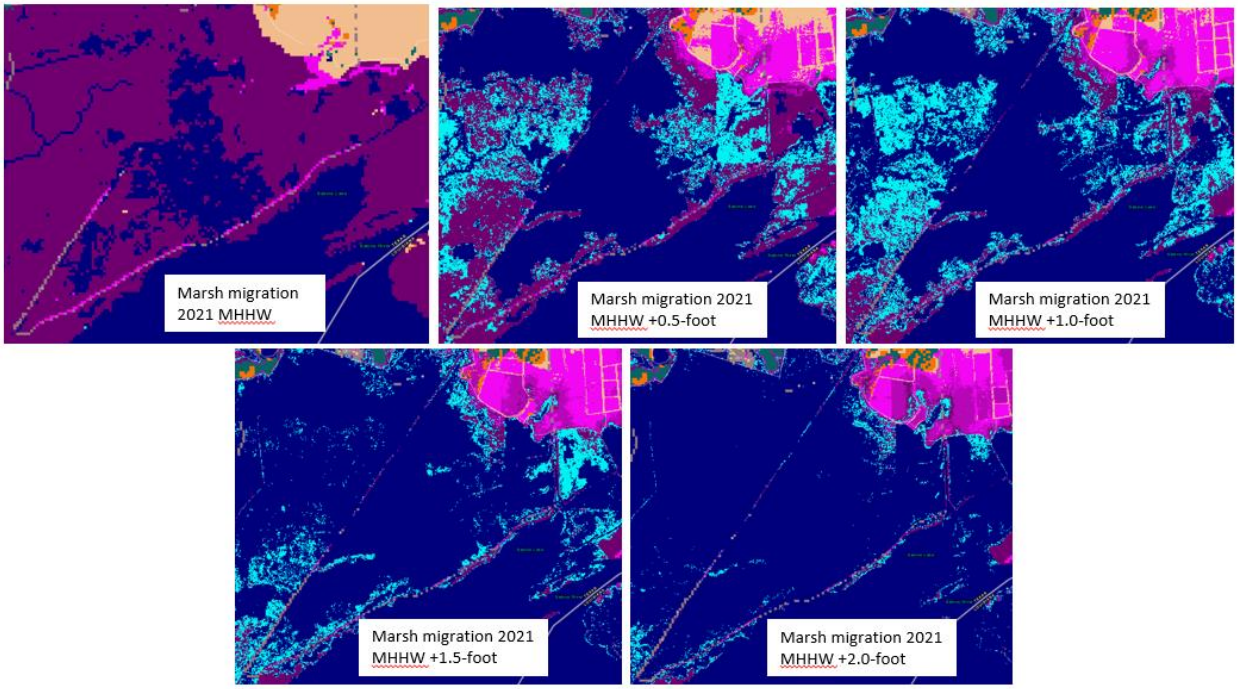

Figure 3-3. Data takes from the NOAA Sea Level Rise Marsh Migration Viewer geospatial tool.

3.3 FUTURE WITH PROJECT

The FWP condition involves the various modeled alternatives each expanding upon the previous to enhance the resiliency of the restored areas to future conditions.

3.3.1 Repair of Containment Levee

By repairing the existing containment levee, restored marsh would be protected from tidal inundation and saltwater intrusion. However, the length of protection is influenced on future breaching caused by erosion or RSLC.

Without erosion protection the repaired levee would be subject to future breaching about 10 years after initial construction, assuming an average erosion rate of existing shoreline of about 2.8 feet per year, as determined by Paine *et al.* (2016) for the Texas bay high bluff shorelines. The rate of marsh loss once the levee is breached was calculated using Google Earth imagery was assumed to follow the historic marsh loss observed in 2005 when the levee first failed (Table 3-4 and Figure 3-4).

Table 3-3. Estimates of Marsh Losses Following 2005 Levee Failure

	Aerial Imagery Year			
	2005	2010	2013	2015
Percent Marsh Remaining	100%	50%	30%	0%

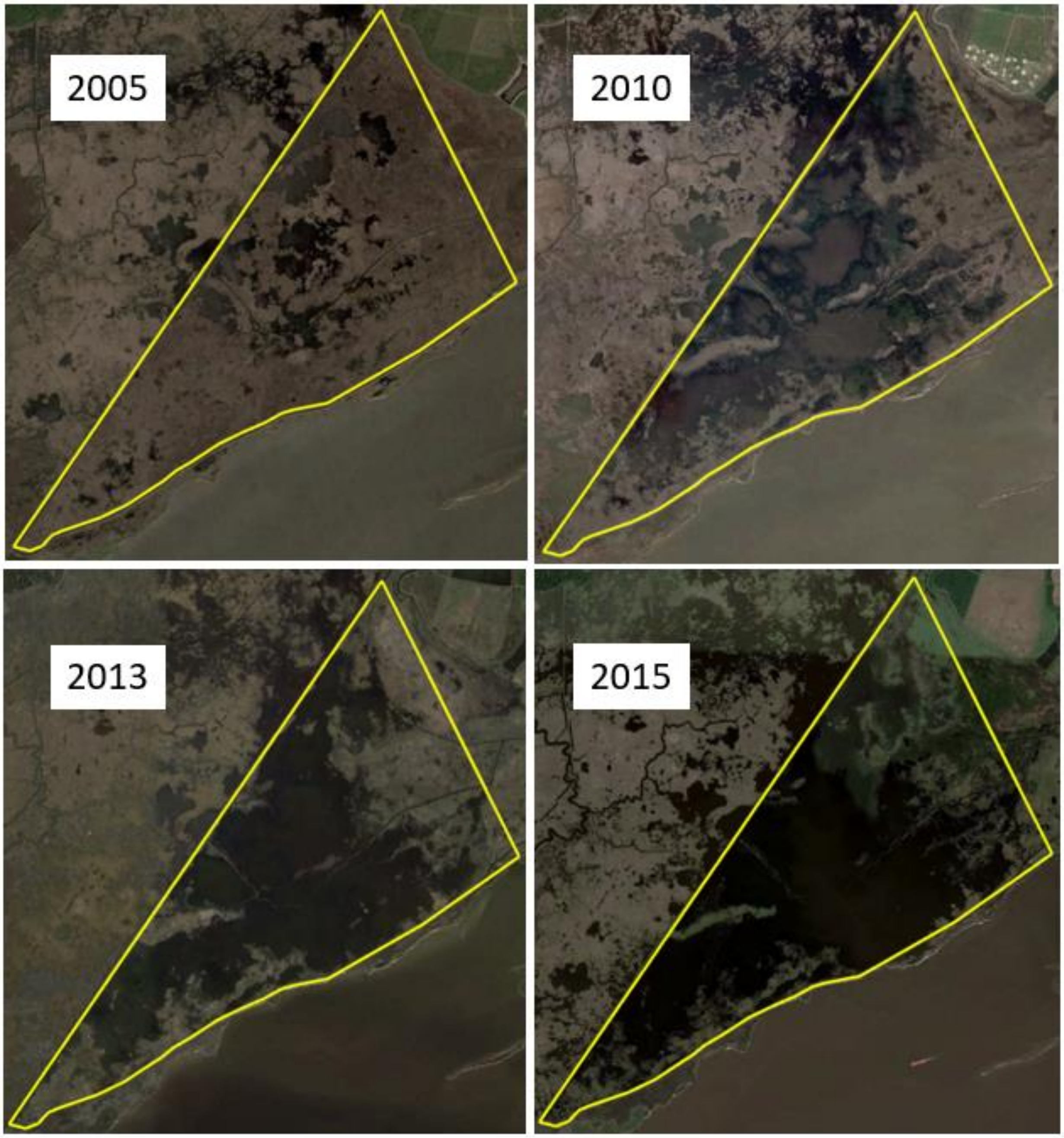

Figure 3-4. Google Earth Aerial Imagery showing progressive marsh loss at Hickory Cove after levee failure from several coastal storms (Hurricane Rita in 2005, Hurricane Humberto in 2007, Hurricane Gustav in 2008, and Hurricane Ike again in 2008).

3.3.2 Restored Marsh Areas

The ICT recommended using the Lower Neches WMA Old River Unit as a reference location to identify target parameters (e.g. substrate elevation, plant species composition, ratio of open water to marsh to higher areas) for project success and as a means to project habitat quality post-construction.

Data was taken within the restored area to represent successfully restored marsh and outside but near the restored area for comparison to the existing conditions at the project site. During the site visit, location data, and elevation data were recorded at four locations (Table 3-4 and Figure 3-5). The restored sample points (LNDP1 and LNDP2) both had an HSI score of 0.6 and the areas outside the restoration units (LNDP3 and LNDP4) had an HSI score of 0.0. Attachment A provides the variable data and calculations.

Table 3-4. Elevation Data, Coordinates, and General Information about the Data Points at the Reference Site (Old River Unit of the Lower Neches WMA).

	Lower Neches Datapoint 1 (LNDP1)	**Lower Neches Datapoint 2 (LNDP2)**	**Lower Neches Datapoint 3 (LNDP3)**	**Lower Neches Datapoint 4 (LNDP4)**
Coordinates:	3593633.477 E 13949521.985 N	3595488.105 E 13954788.432 N	3592931.107 E 13949035.47 N	3592137.307 E 13948849.28 N
Elevation NAVD88 (ft)	0.179	0.435	-1.951	0.212
Restored/not restored	restored	restored	not restored	not restored
Field notes description	edge of restored marsh	internal portion of restored marsh	open water	Degrading area outside of restoration

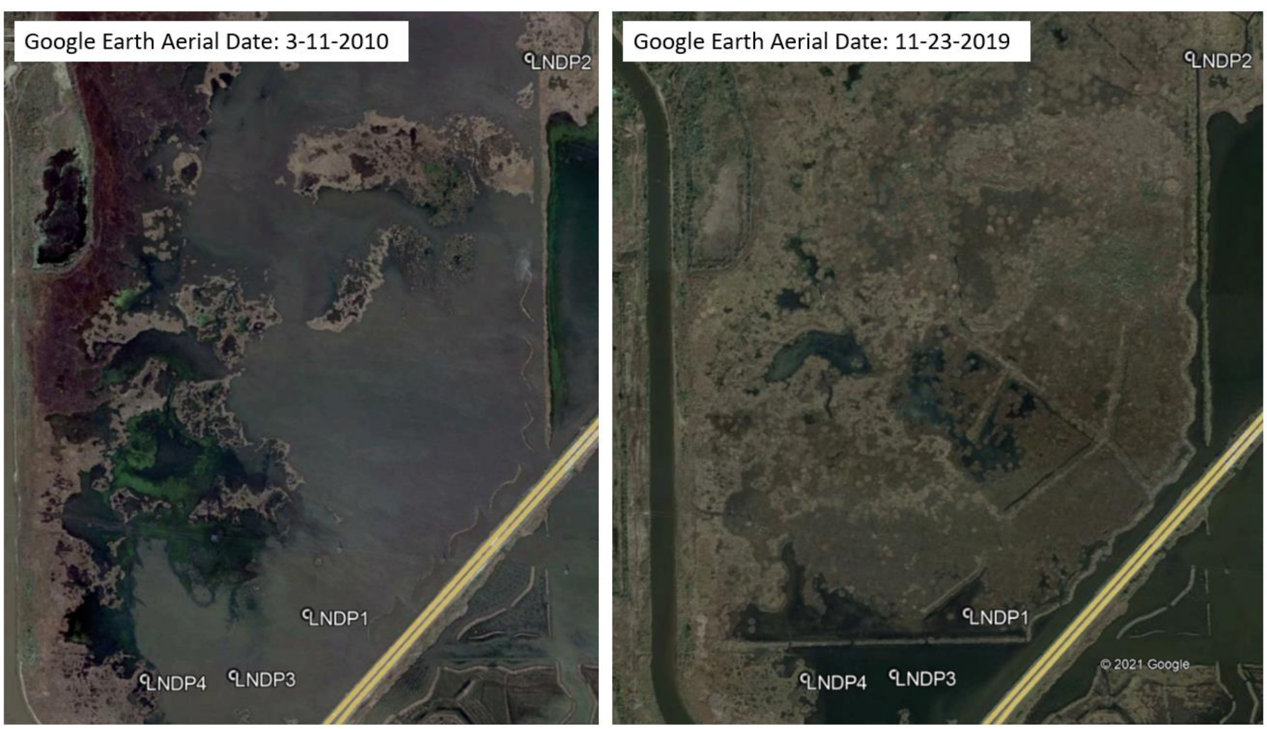

Figure 3-5. Modeling sample locations at the Lower Neches Wildlife Management Area Old River Unit

Aerial imagery from Google Earth was used to estimate the time required for necessary plant communities to establish after dredging restores the appropriate substrate elevations and to achieve a 0.6 suitability score (Table 3-5 and Figure 3-6). It is estimated that it will take 3 years to achieve dense vegetation over 100% of the restored area. These estimates were compared to the settlement rate data provided by TPWD to ensure the conclusions were consistent.

Table 3-5. Target Years for Restoration Success

Imagery Date	Corresponding Target Year	Percentage of restored area containing dense emergent vegetation
March 11, 2010	0	0%
November 10, 2011	1	0%
February 28, 2013	2	60%
October 3, 2014	3	100%

3.3.3 Breakwater Influence

Several studies (Vona *et al.* 2020) have documented the ability of breakwaters to protect shorelines from the effects of wave energy and the ability of those structures to increase sedimentation rates. These findings are consistent with similar nearby projects (McFaddin NWR and JD Murphree WMA), where breakwaters installed along the GIWW accreted marsh habitat between the breakwater and the living shoreline.

For this ecological modeling, the results of two studies (Vona *et al.* 2020 and Feagin and Yeager 2007) were used to estimate the potential effect of the proposed breakwater to increase accretion rates which would dampen the elevation change from RSLC. Vona *et al.* (2020) reported potential increases in sediment deposition into the marsh behind the breakwater averaging 20-40%, proportional to the slope and distance of the breakwater from the shoreline. Feagin and Yeager (2007) used radio isotope analysis and reported that an area with some faulting displacement had an accretion rate on 0.2 cm yr^{-1}. To estimate the increase in accretion expected to occur between the proposed breakwater and the existing shoreline (location of the living shoreline), a 30% (midpoint between 20-40%) increase in accretion (above the assumed baseline 0.2 cm yr^{-1}) was used and resulted in a FWP estimate of 0.26 cm yr^{-1} which was rounded up to approximately 0.1 ft yr^{-1}.

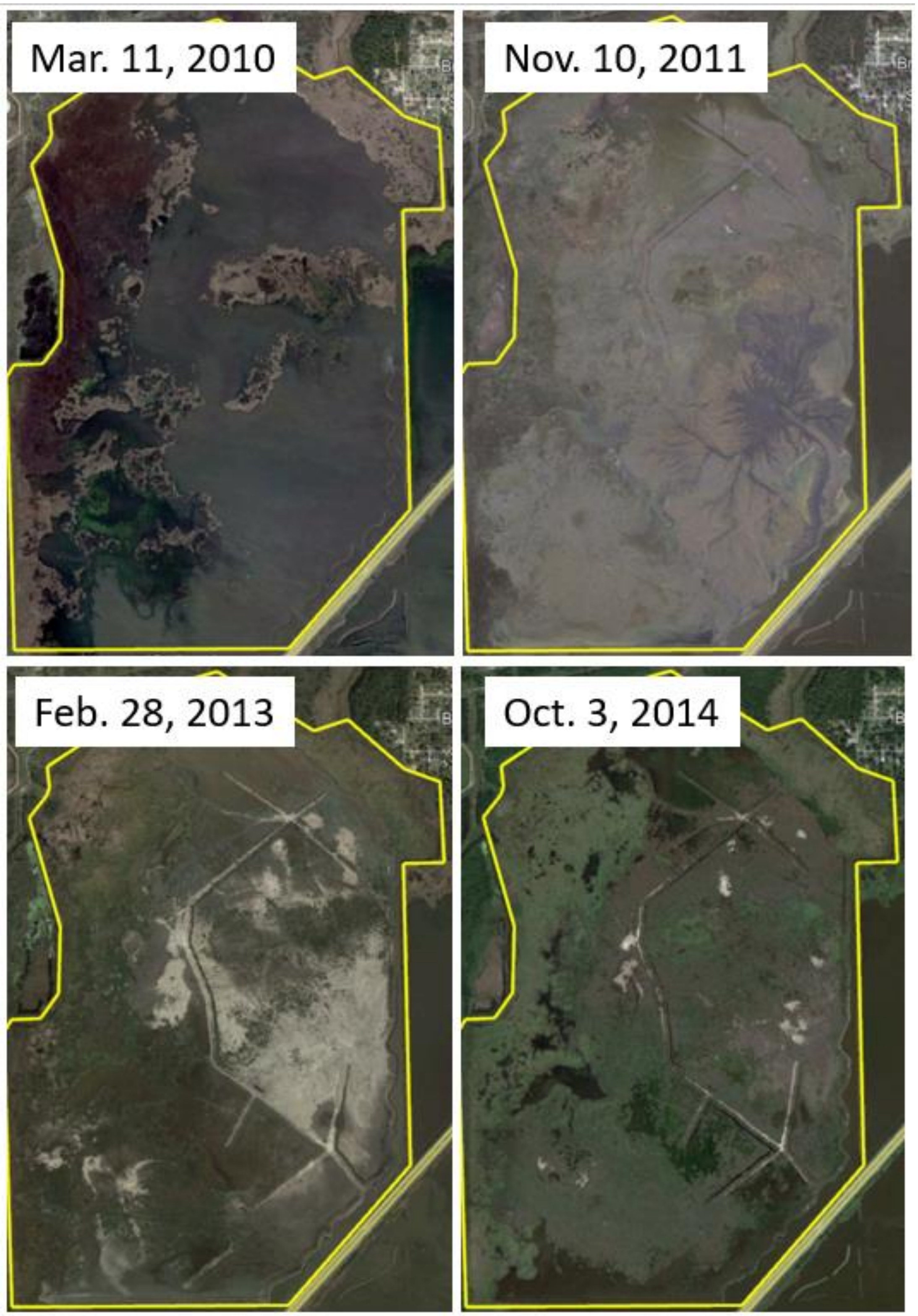

Figure 3-6. Google Earth Imagery depicting recovery of plant communities at the Lower Neches Wildlife Management Area

Table 3-6. FWP Vegetated Surface Area Projections for the Living Shoreline with Breakwater

Target Year	**Years Post-Construction**	**Elevation Change (ft)**			**Acreage of Living Shoreline within *S. alterniflora* preferred elevation range* Elevations given for T_0 in NAVD 88**			
		w/ RSLC	**w/ breakwater**	**w/ accretion**	**-0.5 ft**	**0 ft**	**0.5 ft**	**Remaining Living Shoreline**
2023	0	0	0.0	0	31.7	31.7	31.7	95.1
2042	19	0.5	0.2	0.3	0	31.7	31.7	63.4
2060	37	1.0	0.4	0.6	0	15.8**	31.7	47.5
2075	52*	1.5	0.5	1	0	0	31.7	31.7

* The slope of the living shoreline was assumed to be uniform and the proportion of the area by elevation was estimated to be 25% by half foot increment (31.7 acres =1/3 of ~95 acres)
**-0.6-foot NAVD 88 is within 1/10 of a foot of the acceptable elevation range for *S. alterniflora* so 50% was assumed to remain and 50% was assumed lost.
*** -0.5 to +1-foot NAVD 88 is the presumed acceptable range for *S. alterniflora* with 0.0 to 0.5-foot NAVD 88 considered optimal (*Comm. with TPWD*).

4.0 MODELING RESULTS

As expected, each incremental alternative resulted in more AAHUs, which is reflective of the resiliency provided by the added measures. Alternatives would be expected to produce between 70.5 and 291.7 AAHUs. Table 4-1 shows the net change in AAHUs broken down by measure, as compared to Table 4-2 which shows the net change by alternatives in comparison to the FWOP condition for existing marsh and restored areas.

Table 4-1. Summary of net change in AAHUs anticipated with implementation of each alternative

Alternative	AAHUs					
	Levee Repair W/O Breakwater	Levee Repair W/ Breakwater	BU W/O Breakwater	BU W/ Breakwater	Living Shoreline	Total
1a (68 acres)	61.1	_	9.4	_	_	70.5
1b (126 acres)	61.1	_	17.4	_	_	78.5
1c (190 acres)	61.1	_	26.2	_	_	87.3
2 (190 acres)	_	147.2	_	109.4	_	256.4
3 (190 acres)	_	147.2	_	109.4	35.1	291.7

Table 4-2. Net change in AAHUs

Alt	FWOP (AAHUs)			FWP (AAHUs)			Net Change (AAHUs)		
	Existing Marsh	Restored Area*	Total	Existing Marsh	Restored Area	Total	Existing Marsh	Restored Area	Total
1a	73.0	0.00	73.0	134.1	9.4	143.5	61.1	9.4	70.5
1b	73.0	0.00	73.0	134.1	17.4	151.5	61.1	17.4	78.5
1c	73.0	0.00	73.0	134.1	26.2	160.3	61.1	26.2	87.3
2	73.0	0.00	73.0	220.2	109.4	329.6	147.2	109.4	256.6
3	73.0	0.00	73.0	220.2	144.5+	329.6	147.2	144.5+	291.7

* Restored Area is synonymous with the FWOP existing open water area

\+ This includes the benefits to the existing shoreline and not just the marshes in the interior.

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ATTACHMENT A

Modeling Spreadsheets

Lower Neches Wildlife Management Area (ER Reference Site for Future With Project Conditions Projections)

Site Name= **Lower Neches DP1**

	Variable	**Data Entry Column**	**Suitability Index**
1	Percentage of unsubmerged substrate coverd by rushes, bulrushes, or cattails	0	1
2	Percentage canopy cover of trees and shrubs on unsubmerged substrate	0	1
3	Structure of herbaceous vegetation (excluding rushes, bulrushes, and cattails) on unsubmerged substrate	Growing in clumps; 0.5m to 0.75m (1.64' to 2.46') and/	0.6
4	Percentage of continually submerged substrate covered by woody or herbaceous vegetation	30	0.666
5	Structure of woody or herbaceous emergent vegetation growing in continually submerged substrate	0.3m to 1.0m (1.0' to 3.3') tall and sufficiently dense to	0.6
6	Percentage of study area that is land (substrate not submerged and not supporting growth of rushes, bulrushes, or cattails)	40	1
7	Percentage of continually submerged substrates with water depth less than 30.0 cm (11.8") at low mean tide	100	1
8	Disturbance level	Minimal	0.6

Nesting Hen Cover=	0.8435763
Hen with Brood Cover=	0.6321392
Cover Structure=	0.6321392
Cover Ratio=	1
Reproductive Cover=	0.7367859
Food=	1
Other=	0.6
Mottled Duck HSI=	**0.6**

Site Name= **Lower Neches DP2**

	Variable	**Data Entry Column**	**Suitability Index**
1	Percentage of unsubmerged substrate coverd by rushes, bulrushes, or cattails	50	0.5
2	Percentage canopy cover of trees and shrubs on unsubmerged substrate	0	1
3	Structure of herbaceous vegetation (excluding rushes, bulrushes, and cattails) on unsubmerged substrate	Growing in clumps with overtopping tops; >0.75m (:	1
4	Percentage of continually submerged substrate covered by woody or herbaceous vegetation	20	0.444
5	Structure of woody or herbaceous emergent vegetation growing in continually submerged substrate	0.3m to 1.0m (1.0' to 3.3') tall and sufficiently dense	0.6
6	Percentage of study area that is land (substrate not submerged and not supporting growth of rushes, bulrushes, or cattails)	40	1
7	Percentage of continually submerged substrates with water depth less than 30.0 cm (11.8") at low mean tide	100	1
8	Disturbance level	Minimal	0.6

Nesting Hen Cover=	0.7938839
Hen with Brood Cover=	0.5161395
Cover Structure=	0.5161395
Cover Ratio=	1
Reproductive Cover=	0.6437287
Food=	1
Other=	0.6
Mottled Duck HSI=	**0.6**

Lower Neches Wildlife Management Area (ER Reference Site for No Action Condition Projections)

Site Name= **Lower Neches DP3**

	Variable	**Data Entry Column**	**Suitability Index**
1	Percentage of unsubmerged substrate coverd by rushes, bulrushes, or cattails	0	1
2	Percentage canopy cover of trees and shrubs on unsubmerged substrate	0	1
3	Structure of herbaceous vegetation (excluding rushes, bulrushes, and cattails) on unsubmerged substrate	Not growing in clumps	0.1
4	Percentage of continually submerged substrate covered by woody or herbaceous vegetation	0	0
5	Structure of woody or herbaceous emergent vegetation growing in continually submerged substrate	<0.3m (<1.0') tall or too dense to allow passage of duck	0
6	Percentage of study area that is land (substrate not submerged and not supporting growth of rushes, bulrushes, or cattails)	10	0.25
7	Percentage of continually submerged substrates with water depth less than 30.0 cm (11.8") at low mean tide	20	0.2
8	Disturbance level	Minimal	0.6

Nesting Hen Cover=	0.4645153
Hen with Brood Cover=	0
Cover Structure=	0
Cover Ratio=	0.25
Reproductive Cover=	0
Food=	0.2
Other=	0.6
Mottled Duck HSI=	**0**

Site Name= **Lower Neches DP4**

	Variable	**Data Entry Column**	**Suitability Index**
1	Percentage of unsubmerged substrate coverd by rushes, bulrushes, or cattails	10	0.9
2	Percentage canopy cover of trees and shrubs on unsubmerged substrate	0	1
3	Structure of herbaceous vegetation (excluding rushes, bulrushes, and cattails) on unsubmerged substrate	Growing in clumps; 025m to 0.5m (o.82' to 1.64') ta	0.3
4	Percentage of continually submerged substrate covered by woody or herbaceous vegetation	20	0.444
5	Structure of woody or herbaceous emergent vegetation growing in continually submerged substrate	<0.3m (<1.0') tall or too dense to allow passage of d	0
6	Percentage of study area that is land (substrate not submerged and not supporting growth of rushes, bulrushes, or cattails)	10	0.25
7	Percentage of continually submerged substrates with water depth less than 30.0 cm (11.8") at low mean tide	75	0.75
8	Disturbance level	Minimal	0.6

Nesting Hen Cover=	0.6466126
Hen with Brood Cover=	0
Cover Structure=	0
Cover Ratio=	0.25
Reproductive Cover=	0
Food=	0.75
Other=	0.6
Mottled Duck HSI=	**0**

Hickory Cove -- Existing Marsh (Existing Condition)

Site Name= Hickory Cove Marsh DP1

	Variable	**Data Entry Column**	**Suitability Index**
1	Percentage of unsubmerged substrate coverd by rushes, bulrushes, or cattails	0	1
2	Percentage canopy cover of trees and shrubs on unsubmerged substrate	0	1
3	Structure of herbaceous vegetation (excluding rushes, bulrushes, and cattails) on unsubmerged substrate	Growing in clumps; 025m to 0.5m (o.82' to 1.64') tall a	0.3
4	Percentage of continually submerged substrate covered by woody or herbaceous vegetation	30	0.666
5	Structure of woody or herbaceous emergent vegetation growing in continually submerged substrate	>=0.3m (>=1.0') growing in mats or in sparse stands	0.3
6	Percentage of study area that is land (substrate not submerged and not supporting growth of rushes, bulrushes, or cattails)	10	0.25
7	Percentage of continually submerged substrates with water depth less than 30.0 cm (11.8") at low mean tide	50	0.5
8	Disturbance level	Minimal	0.6

Nesting Hen Cover=	0.6697017
Hen with Brood Cover=	0.4469899
Cover Structure=	0.4469899
Cover Ratio=	0.25
Reproductive Cover=	0.3686484
Food=	0.5
Other=	0.6
Mottled Duck HSI=	**0.3686484**

Site Name= Hickory Cove Marsh DP2

	Variable	**Data Entry Column**	**Suitability Index**
1	Percentage of unsubmerged substrate coverd by rushes, bulrushes, or cattails	0	1
2	Percentage canopy cover of trees and shrubs on unsubmerged substrate	0	1
3	Structure of herbaceous vegetation (excluding rushes, bulrushes, and cattails) on unsubmerged substrate	Growing in clumps; 025m to 0.5m (o.82' to 1.64') ta	0.3
4	Percentage of continually submerged substrate covered by woody or herbaceous vegetation	20	0.444
5	Structure of woody or herbaceous emergent vegetation growing in continually submerged substrate	>=0.3m (>=1.0') growing in mats or in sparse stands	0.3
6	Percentage of study area that is land (substrate not submerged and not supporting growth of rushes, bulrushes, or cattails)	10	0.25
7	Percentage of continually submerged substrates with water depth less than 30.0 cm (11.8") at low mean tide	50	0.5
8	Disturbance level	Minimal	0.6

Nesting Hen Cover=	0.6697017
Hen with Brood Cover=	0.3649658
Cover Structure=	0.3649658
Cover Ratio=	0.25
Reproductive Cover=	0.3220875
Food=	0.5
Other=	0.6
Mottled Duck HSI=	**0.3220875**

Hickory Cove -- Existing Open Water (Existing Condition)

Site Name= Hickory Cove Marsh DP3

	Variable	**Data Entry Column**	**Suitability Index**
1	Percentage of unsubmerged substrate coverd by rushes, bulrushes, or cattails	0	1
2	Percentage canopy cover of trees and shrubs on unsubmerged substrate	0	1
3	Structure of herbaceous vegetation (excluding rushes, bulrushes, and cattails) on unsubmerged substrate	Not growing in clumps	0.1
4	Percentage of continually submerged substrate covered by woody or herbaceous vegetation	0	0
5	Structure of woody or herbaceous emergent vegetation growing in continually submerged substrate	<0.3m (<1.0') tall or too dense to allow passage of duck	0
6	Percentage of study area that is land (substrate not submerged and not supporting growth of rushes, bulrushes, or cattails)	0	0
7	Percentage of continually submerged substrates with water depth less than 30.0 cm (11.8") at low mean tide	75	0.75
8	Disturbance level	Minimal	0.6

Nesting Hen Cover=	0.4645153
Hen with Brood Cover=	0
Cover Structure=	0
Cover Ratio=	0
Reproductive Cover=	0
Food=	0.75
Other=	0.6
Mottled Duck HSI=	**0**

Site Name= Hickory Cove Marsh DP4

	Variable	**Data Entry Column**	**Suitability Index**
1	Percentage of unsubmerged substrate coverd by rushes, bulrushes, or cattails	0	1
2	Percentage canopy cover of trees and shrubs on unsubmerged substrate	0	1
3	Structure of herbaceous vegetation (excluding rushes, bulrushes, and cattails) on unsubmerged substrate	Not growing in clumps	0.1
4	Percentage of continually submerged substrate covered by woody or herbaceous vegetation	0	0
5	Structure of woody or herbaceous emergent vegetation growing in continually submerged substrate	<0.3m (<1.0') tall or too dense to allow passage of d	0
6	Percentage of study area that is land (substrate not submerged and not supporting growth of rushes, bulrushes, or cattails)	0	0
7	Percentage of continually submerged substrates with water depth less than 30.0 cm (11.8") at low mean tide	50	0.5
8	Disturbance level	Minimal	0.6

Nesting Hen Cover=	0.4645153
Hen with Brood Cover=	0
Cover Structure=	0
Cover Ratio=	0
Reproductive Cover=	0
Food=	0.5
Other=	0.6
Mottled Duck HSI=	**0**

Alternative 1A

Existing Marsh

Condition: Future Without Project
(Existing Containment Levee Continues to Breach)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	157	0.35	54.95	2613.45
37	94	0.35	32.90	790.65
50	13	0.35	4.55	243.43
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	**50**		**AAHUs=**	**73.0**

Condition: Future With Project
(Existing Containment Levee Restored)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	629	0.35	220.15	4182.85
37	94	0.35	32.90	2277.45
50	13	0.35	4.55	243.43
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	**50**		**AAHUs=**	**134.1**

Model Assumptions:
Existing Marsh Acres: 629 acres
TY10= Levee Failure
TY19= +0.5 ft RSLR, converts 25% of existing marsh to open water
TY37= +1.0 ft RSLR, converts 85% of existing marsh to open water
TY50= +1.5 ft RSLR, converts 98% of existing marsh to open water

Existing Open Water

Condition: Future Without Project
(Existing Containment Levee Continues to Breach, No Marsh Restoration)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	0	0.00	0.00	
1	0	0.60	0.00	0.00
2	0	0.60	0.00	0.00
3	0	0.60	0.00	0.00
15	0	0.60	0.00	0.00
18	0	0.60	0.00	0.00
20	0	0.60	0.00	0.00
50	0	0.60	0.00	0.00
			0.00	0.00
Max TY=	**50**		**AAHUs=**	**0.0**

Condition: Future With Project
(Existing Containment Levee Restored and Dredged Material Placed in Open Water to Restore Marsh)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	0	0.00	0.00	
1	0	0.00	0.00	0.00
2	41	0.60	24.48	8.16
3	68	0.60	40.80	32.64
15	34	0.60	20.40	367.20
18	20	0.60	12.24	48.96
20	0	0.60	0.00	12.24
50	0	0.60	0.00	0.00
			0.00	0.00
Max TY=	**50**		**AAHUs=**	**9.4**

FWP Model Assumptions:
Marsh Acres Restored: 68 acres
TY2= 60% of marsh successfully restored (based on ref site)
TY3= 100% of marsh successfully restored (based on ref site)
TY10= Levee Failure
TY15= 50% of restored marsh remaining (34 acres)
TY18= 30% of restored marsh remaining (20.4 acres)
TY20= 0% of restored marsh remaining

Alt 1A -- Net Change in AAHUs

	Existing Marsh	Existing Open Water	Total
Future With Project AAHUs	134.1	9.4	143.5
Future Without Project AAHUs	73.0	0.0	73.0
Net Change	61.1	9.4	70.5

Alternative 1B

Existing Marsh

Condition: Future Without Project
(Existing Containment Levee Continues to Breach)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	157	0.35	54.95	2613.45
37	94	0.35	32.90	790.65
50	13	0.35	4.55	243.43
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	73.0

Condition: Future With Project
(Existing Containment Levee Restored)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	629	0.35	220.15	4182.85
37	94	0.35	32.90	2277.45
50	13	0.35	4.55	243.43
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	134.1

Model Assumptions:
Existing Marsh Acres: 629 acres
TY10= Levee Failure
TY19= +0.5 ft RSLR, converts 25% of existing marsh to open water
TY37= +1.0 ft RSLR, converts 85% of existing marsh to open water
TY50= +1.5 ft RSLR, converts 98% of existing marsh to open water

Existing Open Water

Condition: Future Without Project
(Existing Containment Levee Continues to Breach, No Marsh

TY	Acres	HSI	Total HUs	Cumulative HUs
0	0	0.00	0.00	
1	0	0.00	0.00	0.00
2	0	0.60	0.00	0.00
3	0	0.60	0.00	0.00
15	0	0.60	0.00	0.00
18	0	0.60	0.00	0.00
20	0	0.60	0.00	0.00
50	0	0.00	0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	0.0

Condition: Future With Project
(Existing Containment Levee Restored and Dredged Material Placed in Open Water to Restore Marsh)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	0	0.00	0.00	
1	0	0.00	0.00	0.00
2	76	0.60	45.36	15.12
3	126	0.60	75.60	60.48
15	63	0.60	37.80	680.40
18	38	0.60	22.68	90.72
20	0	0.60	0.00	22.68
50	0	0.00	0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	17.4

FWP Model Assumptions:
Marsh Acres Restored: 126 acres
TY2= 60% of marsh successfully restored (based on ref site)
TY3= 100% of marsh successfully restored (based on ref site)
TY10= Levee Failure
TY15= 50% of restored marsh remaining
TY18= 30% of restored marsh remaining
TY20= 0% of restored marsh remaining

Alt 1B -- Net Change in AAHUs

	Existing Marsh	Existing Open Water	Total
Future With Project AAHUs	134.1	17.4	151.5
Future Without Project AAHUs	73.0	0.0	73.0
Net Change	61.1	17.4	78.5

Alternative 1C

Existing Marsh

Condition: Future Without Project
(Existing Containment Levee Continues to Breach)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	157	0.35	54.95	2613.45
37	94	0.35	32.90	790.65
50	13	0.35	4.55	243.43
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	73.0

Condition: Future With Project
(Existing Containment Levee Restored)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	629	0.35	220.15	4182.85
37	94	0.35	32.90	2277.45
50	13	0.35	4.55	243.43
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	134.1

Model Assumptions:
Existing Marsh Acres: 629 acres
TY10= Levee Failure
TY19= +0.5 ft RSLR, converts 25% of existing marsh to open water
TY37= +1.0 ft RSLR, converts 85% of existing marsh to open water
TY50= +1.5 ft RSLR, converts 98% of existing marsh to open water

Existing Open Water

Condition: Future Without Project
(Existing Containment Levee Continues to Breach, No Marsh Restoration)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	0	0.00	0.00	
1	0	0.00	0.00	0.00
2	0	0.60	0.00	0.00
3	0	0.60	0.00	0.00
15	0	0.60	0.00	0.00
18	0	0.60	0.00	0.00
20	0	0.60	0.00	0.00
50	0	0.00	0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	0.0

Condition: Future With Project
(Existing Containment Levee Restored and Dredged Material Placed in Open Water to Restore Marsh)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	0	0.00	0.00	
1	0	0.00	0.00	0.00
2	114	0.60	68.40	22.80
3	190	0.60	114.00	91.20
15	95	0.60	57.00	1026.00
18	57	0.60	34.20	136.80
20	0	0.60	0.00	34.20
50	0	0.00	0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	26.2

FWP Model Assumptions:
Marsh Acres Restored: 190 acres
TY2= 60% of marsh successfully restored (based on ref site)
TY3= 100% of marsh successfully restored (based on ref site)
TY10= Levee Failure
TY15= 50% of restored marsh remaining
TY18= 30% of restored marsh remaining
TY20= 0% of restored marsh remaining

Alt 1C -- Net Change in AAHUs

	Existing Marsh	Existing Open Water	Total
Future With Project AAHUs	134.1	26.2	160.3
Future Without Project AAHUs	73.0	0.0	73.0
Net Change	61.1	26.2	87.3

Alternative 2

Existing Marsh

Condition: Future Without Project
(Existing Containment Levee Continues to Breach)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	157	0.35	54.95	2613.45
37	94	0.35	32.90	790.65
50	13	0.35	4.55	243.43
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	73.0

Condition: Future With Project
(Existing Containment Levee Restored and Protected by a Breakwater)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	629	0.35	220.15	4182.85
37	629	0.35	220.15	3962.70
50	629	0.35	220.15	2861.95
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	220.2

FWP Model Assumptions:
Existing Marsh Acres: 629 acres
No Levee Failure
Levee assumed of sufficient height to protect against SLR

Existing Open Water

Condition: Future Without Project
(Existing Containment Levee Continues to Breach, No Marsh Restoration)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	190	0.00	0.00	
1	190	0.00	0.00	0.00
2	190	0.00	0.00	0.00
3	190	0.00	0.00	0.00
19	190	0.00	0.00	0.00
37	190	0.00	0.00	0.00
50	190	0.00	0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	0.0

Condition: Future With Project
(Existing Containment Levee Restored, Breakwaters Constructed, and Dredged Material Placed in Open Water to Restore Marsh)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	0	0.00	0.00	
1	0	0.00	0.00	0.00
2	114	0.60	68.40	22.80
3	190	0.60	114.00	91.20
19	190	0.60	114.00	1824.00
37	190	0.60	114.00	2052.00
50	190	0.60	114.00	1482.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	109.4

FWP Model Assumptions:
Marsh Acres Restored: 190 acres
TY2= 60% of marsh successfully restored (based on ref site)
TY3= 100% of marsh successfully restored (based on ref site)
No Levee Failure

Alt 2 -- Net Change in AAHUs

	Existing Marsh	Existing Open Water	Total
Future With Project AAHUs	220.2	109.4	329.6
Future Without Project AAHUs	73.0	0.0	73.0
Net Change	147.2	109.4	256.6

Alternative 3

Existing Marsh

Condition: Future Without Project
(Existing Containment Levee Continues to Breach)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	157	0.35	54.95	2613.45
37	94	0.35	32.90	790.65
50	13	0.35	4.55	243.43
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	73.0

Condition: Future With Project
(Existing Containment Levee Restored and Protected by a Breakwater)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	629	0.35	220.15	
19	629	0.35	220.15	4182.85
37	629	0.35	220.15	3962.70
50	629	0.35	220.15	2861.95
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	220.2

FWP Model Assumptions:
Existing Marsh Acres: 629 acres
No Levee Failure

Existing Open Water

Condition: Future Without Project
(Existing Containment Levee Continues to Breach, No Marsh Restoration)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	190	0.00	0.00	
1	190	0.00	0.00	0.00
2	190	0.00	0.00	0.00
3	190	0.00	0.00	0.00
19	190	0.00	0.00	0.00
37	190	0.00	0.00	0.00
50	190	0.00	0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	0.0

Condition: Future With Project
(Existing Containment Levee Restored, Breakwaters Constructed, and Dredged Material Placed in Open Water to Restore Marsh)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	0	0.00	0.00	
1	0	0.00	0.00	0.00
2	114	0.60	68.40	22.80
3	190	0.60	114.00	91.20
19	190	0.60	114.00	1824.00
37	190	0.60	114.00	2052.00
50	190	0.60	114.00	1482.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	109.4

FWP Model Assumptions:
Marsh Acres Restored: 190 acres
TY2= 60% of marsh successfully restored (based on ref site)
TY3= 100% of marsh successfully restored (based on ref site)
No Levee Failure

Existing Shoreline

Condition: Future Without Project
(Existing shoreline continues to erode)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	0	0.00	0.00	
1	0	0.00	0.00	0.00
2	0	0.00	0.00	0.00
3	0	0.00	0.00	0.00
19	0	0.00	0.00	0.00
37	0	0.00	0.00	0.00
50	0	0.00	0.00	0.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	0.0

Condition: Future With Project
(Living shoreline constructed along the existing shoreline on the exterior of the containment levee)

TY	Acres	HSI	Total HUs	Cumulative HUs
0	95	0.00	0.00	
1	95	0.00	0.00	0.00
2	95	0.60	57.00	28.50
3	95	0.60	57.00	57.00
19	63	0.60	37.80	758.40
37	48	0.60	28.80	599.40
50	32	0.60	19.20	312.00
			0.00	0.00
			0.00	0.00
Max TY=	50		AAHUs=	35.1

Model Assumptions:
Restored Marsh Acres: 95 acres
TY19= +0.5 ft RSLR, converts 25% of existing marsh to open water
TY37= +1.0 ft RSLR, converts 85% of existing marsh to open water
TY50= +1.5 ft RSLR, converts 98% of existing marsh to open water

Alt 3 -- Net Change in AAHUs

	Existing Marsh	Existing Open Water	Existing Shoreline	Total
Future With Project AAHUs	220.2	109.4	35.1	364.7
Future Without Project AAHUs	73.0	0.0	0.0	73.0
Net Change	147.2	109.4	35.1	291.7

Appendix C
Real Estate

Hickory Cove Marsh Restoration & Living Shoreline
Bridge City, TX

WRDA 2016 Section 1122
Beneficial Use of Dredged Material Pilot Program

October 2021

US Army Corps
of Engineers®
Galveston District

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List of Acronyms

API	American Petroleum Institute
BCE	Baseline Cost Estimate
CESWG-RE	Galveston District, Real Estate Division
DI	Design and Implementation Phase
GLO	Texas General Land Office
HQUSACE	U.S. Army Corps of Engineers Headquarters
HTRW	Hazardous, Toxic, and Radioactive Waste
LERRD	Lands, Easements, Rights-of-Way, Relocations, and Disposals
NFS	Non-Federal Sponsor
O&M	Operations & Maintenance
PA	Placement Area
PDT	Project Delivery Team
PGL	Policy Guidance Letter
PL	Public Law
PPA	Project Partnership Agreement
REP	Real Estate Plan
ROM	Rough Order of Magnitude
SNWW	Sabine-Neches Waterway
USACE	U.S. Army Corps of Engineers
WRDA	Water Resources Development Act

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1 General Background

This Real Estate Plan (REP) is the real estate work product of the U.S. Army Corps of Engineers (USACE), Galveston District, Real Estate Division that supports the Hickory Cove Marsh Restoration & Living Shoreline Study. It identifies and describes the lands, easements, rights-of-way, relocations, and disposals (LERRD) required for the construction, operation and maintenance of the proposed project, including those required for relocations (i.e., P.L. 91-646 relocations and utility/facility relocations), borrow material, and dredged or excavated material disposal. Furthermore, the REP describes the estimated LERRD value, together with the estimated administrative and incidental costs attributable to providing LERRD, and the acquisition process.

This report is prepared based on specific data from the USACE, Galveston District Project Delivery Team (PDT) for the Hickory Cove Marsh Restoration & Living Shoreline Study. However, this plan is tentative in nature and intended for planning purposes only. Modifications to the recommended plan could occur and change the determinations of real property lines, estimations of values, and rights required for the project, etc. as outlined in this plan, even after final report approval. The level of detail provided in this REP is understood to be equivalent to the other PDT disciplines.

2 Project Type and Purpose

The Hickory Cove Marsh Restoration & Living Shoreline project is one of only 10 proposals evaluated and selected by a panel of reviewers from Southwestern Division and Headquarters for inclusion in the Section 1122 Beneficial Use of Dredged Material pilot program. The pilot program evaluated 95 proposals and identified projects for the pilot program that could accomplish the purposes of:

- reducing storm damage to property and infrastructure;
- promoting public safety;
- protecting, restoring, and creating aquatic ecosystem habitats;
- stabilizing stream systems and enhancing shorelines;
- promoting recreation;
- supporting risk management adaptation strategies; and
- reducing the cost of dredging and dredged material placement or disposal, such projects that use dredged material for construction or fill material, civic improvement objectives; and other innovative uses and placement alternatives that produce public economic or environmental benefits.

The proposal was submitted to USACE by Ducks Unlimited to propose using the dredged material from the Sabine and/or Neches Rivers to restore the Hickory Cove marsh area. This area is an important habitat for wintering migratory waterfowl and other water birds, specifically the Northern Pintail (wintering and migratory resident) and the Mottled Duck (year-round resident). Additionally, the Texas General Land Office (GLO) specifically identified the Hickory Cove area as a statewide priority for coastal resiliency planning. GLO expects the restoration of the coastal marsh will provide storm surge protection and a buffer for critical petrochemical infrastructure, as well as for residents and other businesses in the Bridge City and Orange areas. This area was significantly impacted by Hurricane Ike in 2008 and more recently by Hurricane Harvey in 2017.

The project seeks to obtain dredged material from a six (6) mile stretch of the Sabine Neches Waterway (SNNW) from the intersection of the Neches and Sabine Rivers, extending north towards the Port of Orange. A highlight of this project is the relatively short pumping distance from the waterway to the proposed placement site of between one (1) to three (3) miles.

3 Study Scope

This feasibility study focused on measures and alternatives, which simultaneously meet the criteria for inclusion within the Section 1122 pilot program and address the problems, opportunities, and constraints set forth by the study authority. Specifically, this project's scope is to beneficially utilize the dredged material from the SNWW to restore the Hickory Cove Marsh area.

4 Authority

The authority for this project is Section 1122 of the Water Resources Development Act (WRDA) of 2016, Beneficial Use of Dredged Material. Section 1122 of WRDA 2016 (a-h) directs the Secretary to establish a pilot program consisting of 10 projects for the beneficial use of dredged material for certain, specified purposes. It provides for the establishment of regional beneficial use terms to identify and assist in implementation of projects under the pilot program.

5 Study Area and Project Location

The study area is situated in Orange County in the easternmost part of Texas, adjacent to the Louisiana border (Figure 1). The closest city is Bridge City, which is located approximately 3.5 miles northwest of Hickory Cove Bay in Orange County, Texas (Figure 2). The project location is located within Hickory Cove Bay. The total scope of the analysis is approximately 1,700 acres in size and located adjacent to the Sabine River (Figure 3). Material from a six (6) mile reach of the SNWW beginning at the intersection of the Neches and Sabine Rivers extending north towards the Port of Orange will be utilized.

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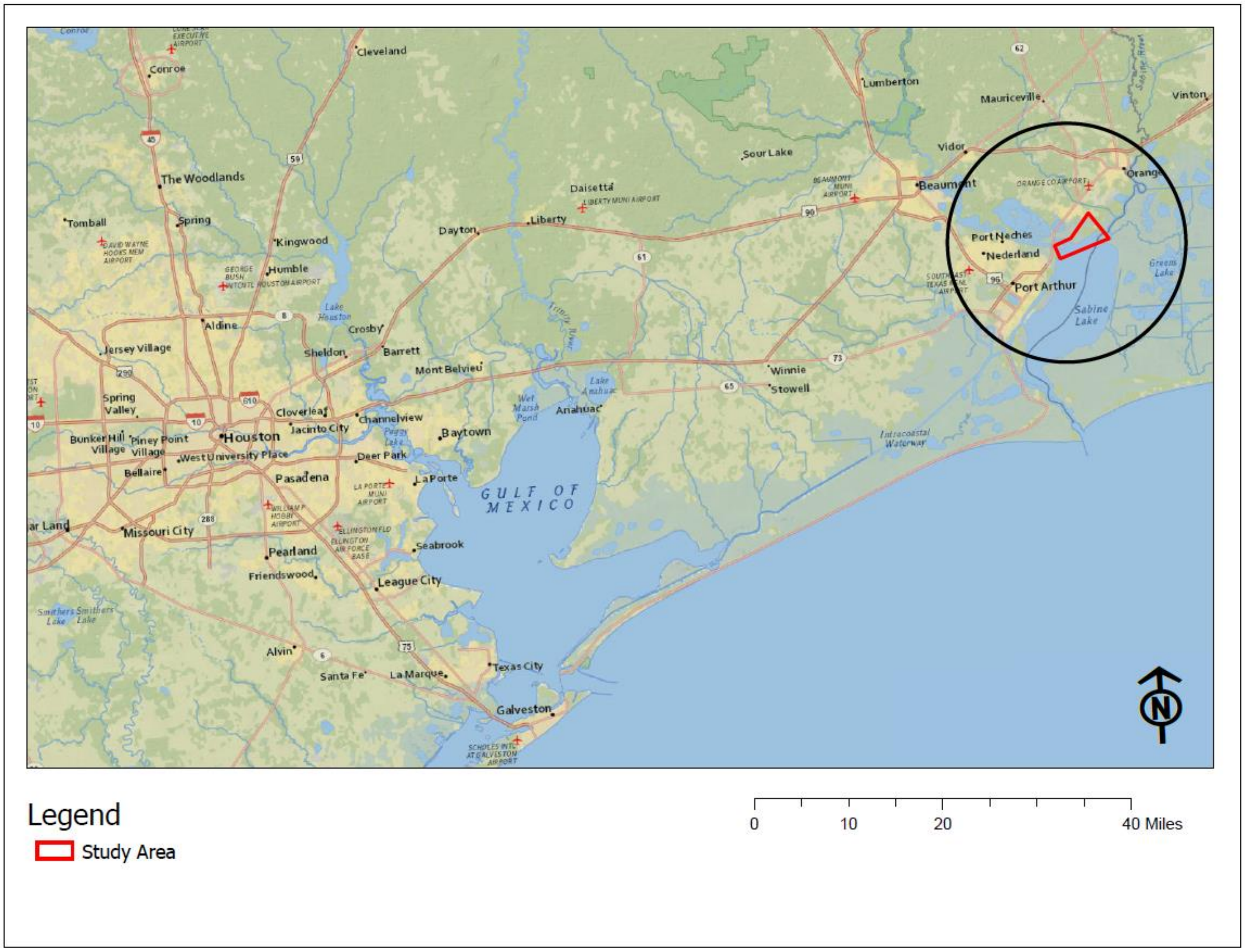

Figure 1: Study Area in Relation to Houston/Galveston

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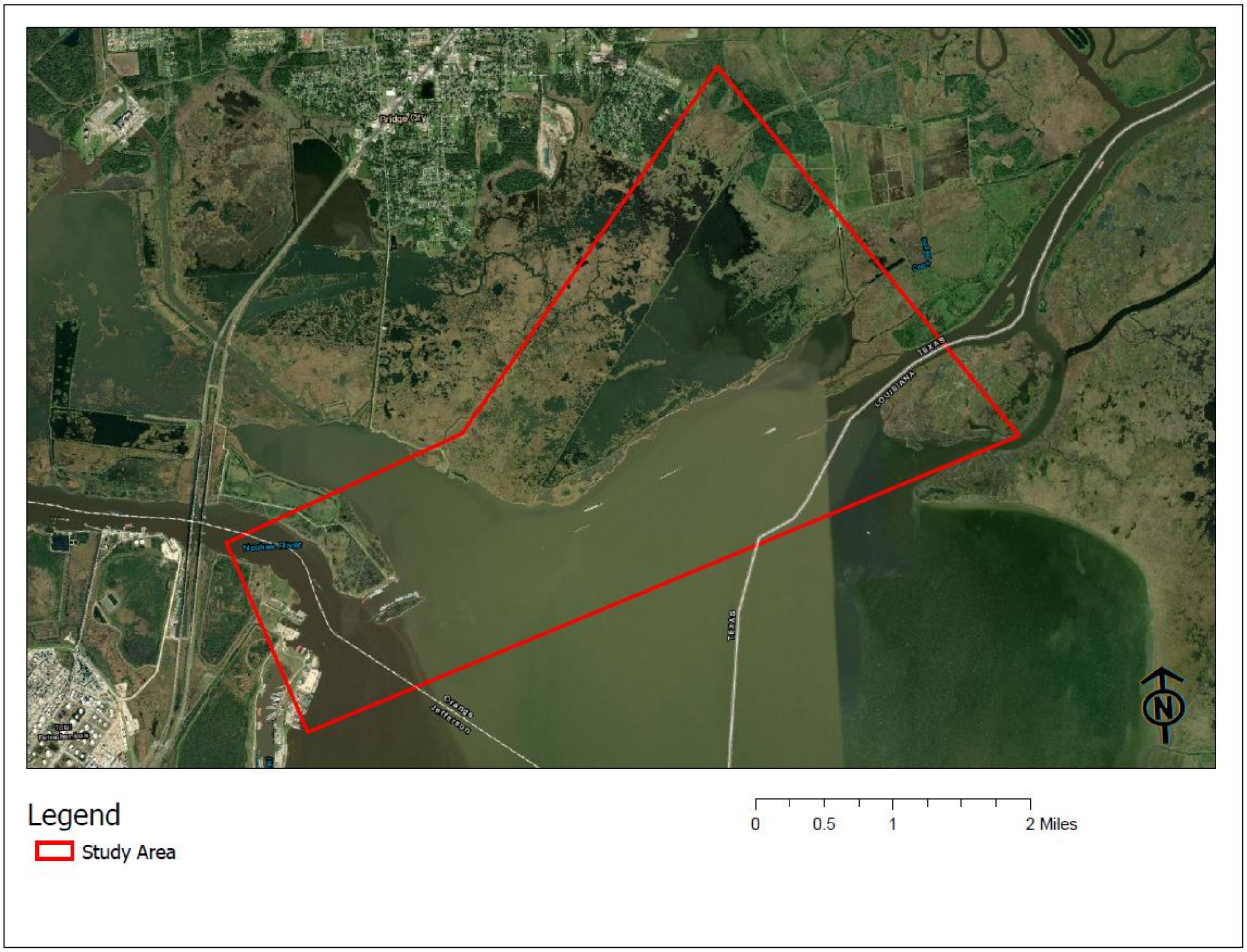

Figure 2: Study Area in Relation to Bridge City, TX

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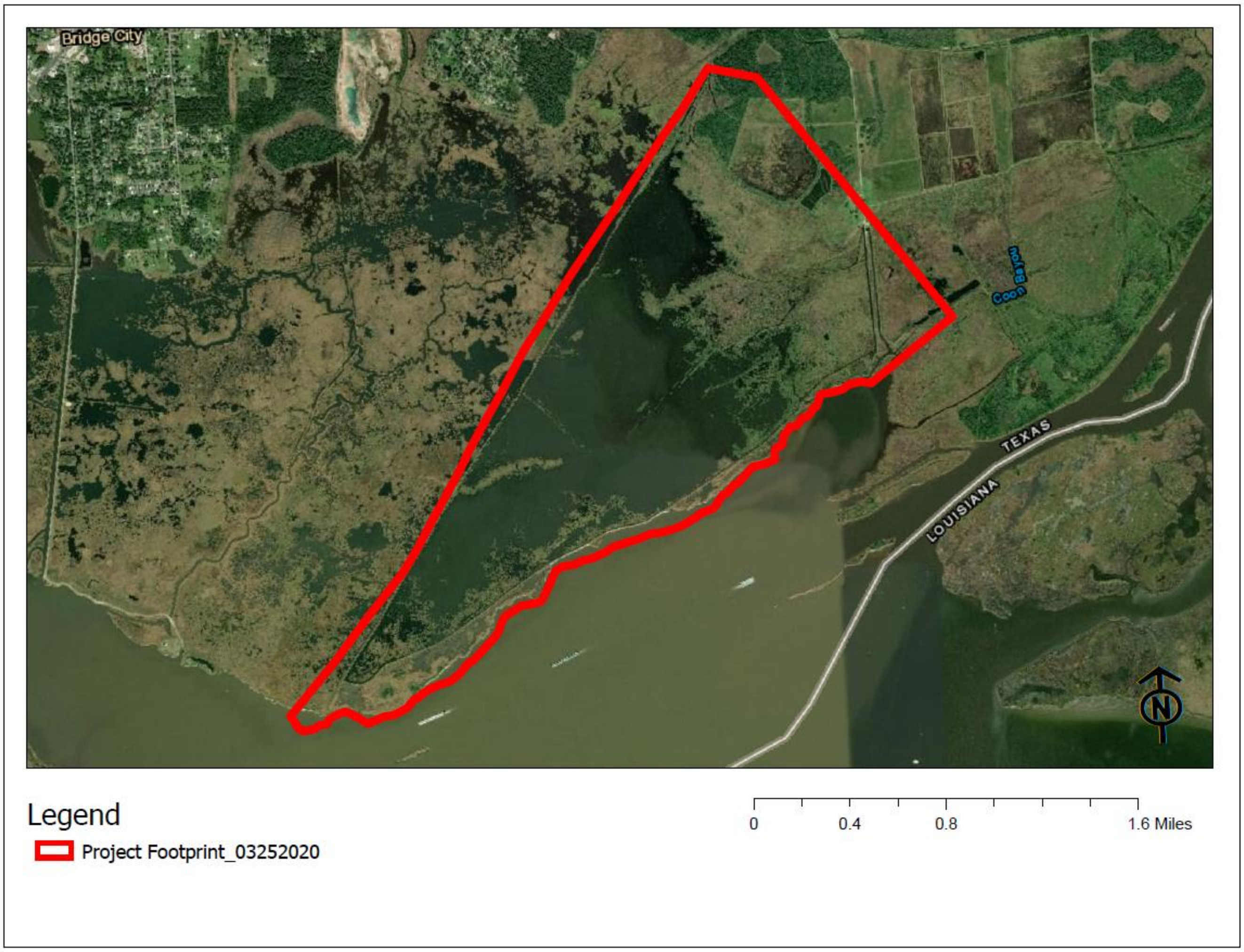

Figure 3: Project Area

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6 Non-Federal Sponsors, Partners and Acquisition Responsibilities

6.1 Non-Federal Sponsor

As part of the Section 1122 Pilot Program, the feasibility portion of the study was done at 100% federal expense. To accomplish the Design & Implementation (DI) portion of the study, USACE has identified the Orange County Navigation & Port District (Port of Orange) as a potential Non-Federal Sponsor (NFS) for this project. The Port of Orange has actively participated in the feasibility portion of the project, attending site visits and PDT meetings.

6.2 Other Study Participants

As the entity that submitted the Section 1122 proposal, Ducks Unlimited has also actively participated in the feasibility portion of the project by attending site visits and PDT meetings. Ducks Unlimited is not an official study sponsor or partner.

6.3 NFS Acquisition Responsibilities and Capabilities

The NFS is responsible for providing all LERRD required for the project. An acquisition capabilities assessment has been completed for the Port of Orange (Exhibit A). While the Port of Orange has the authority and capability to furnish the private lands, easements, and rights-of-way for this project, they are unwilling to exercise condemnation authority on private lands. The PDT has determined this to be of minimal risk to the project and further details are outlined in Section 10.6.1.

7 NFS Notification of Risk

Real Estate has notified the NFS of the risks in acquiring land prior to the signing of the Project Partnership Agreement (PPA). A copy of the risk letter is shown in Exhibit B.

8 Alternative Formulation Process and Recommended Plan

The project set out to restore habitats and attenuate coastal storm forces to enhance the resiliency of portions of Bridge City, Texas and surrounding areas through beneficial use of dredged material from the Sabine River. The PDT evaluated alternatives designed to:

- reduce storm damage to property;
- protect, restore, and create aquatic and ecologically related habitats that include wetlands; and
- transport and place suitable sediment for the purposes of improving environmental conditions in the marsh and littoral systems, stabilizing stream channels, and enhancing shorelines.

8.1 Alternatives Considered

The PDT considered the following alternatives:

- No Action – Maintenance dredging within the Sabine River section of the SNWW navigation channel would occur infrequently, as routine maintenance of the waterway has been limited due to the lack of placement areas. Site improvements would be required for Placement Areas 29A and 29 B, for placement of dredged material.
- Hickory Cove Marsh Placement with a series of incremental measures:
    - Alternative 1: Restoring marsh to a target elevation for vegetation establishment utilizing dredged material on three potential scales based on estimated volumes (Figure 4). Future dredging volumes are variable as a result of storm conditions, available funding and the dredging depth and extent. The maximum quantity of sediment is considered for the marsh restoration, by may vary by the time of construction. The uncertainty was addressed by considering different volumes and found to be feasible. This alternative

would restore an existing containment levee and restore marsh habitat. It does not include a breakwater or living shoreline.

- 1a: Marsh restoration based on 500,000 cy of material.
- 1b: Marsh restoration based on 900,000 cy of material.
- 1c: Marsh restoration based on 1,300,000 cy of material.

Figure 4: Alternative 1

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- Alternative 2: This alternative builds upon Alternative 1 by including shoreline protection in the form of a detached breakwater to armor the shoreline along the SNWW to reduce erosion of sediment and ensure sustainability of the marsh (Figure 5). The proposed breakwater is approximately 14,623 linear feet.

Figure 5: Alternative 2

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- Alternative 3: Alternative 3 adds a living shoreline to Alternative 2 to provide a comprehensive solution that would include marsh restoration, breakwater shore protection, as well as additional sediment and vegetation between the containment levee and the breakwater to produce additional habitat (Figure 6).

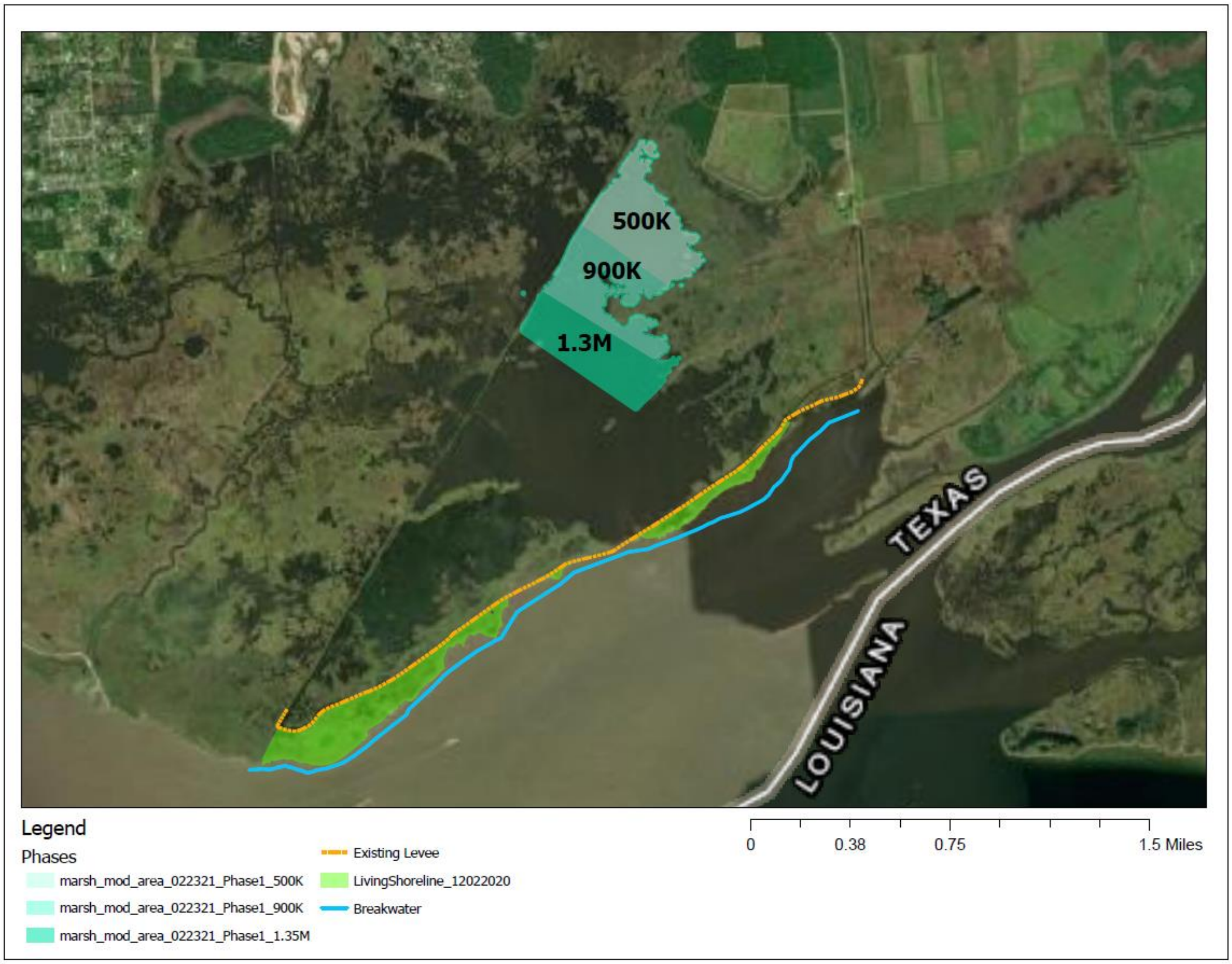

Figure 6: Alternative 3

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While not included in the above alternatives, the study also identified two additional increments of marsh modification and restoration that could be completed at a later date, should dredged material become available. The second increment would restore an additional 260 acres of marsh, with the third increment restoring the final 157 acres of marsh (Figure 7) This was proposed to facilitate continued dredging and marsh restoration opportunities into the future, and to encourage additional BU over time.

Figure 7: Additional Increments

8.2 Recommended Plan

The recommended plan is Alternative 3 (Figure 6). Alternative 3 would beneficially use 1.3 mcy of dredged material from the SNWW to restore approximately 190 acres of marsh within a 1200-acre impoundment at Hickory Cove in Orange County, Texas. The restoration will raise the elevation of the marsh with placement of sediment, removal of invasive species and planting of desired vegetation. The total scope of analysis for the project includes repairs to breaches in the southeast levee of the impoundment and the installation of a breakwater and living shoreline on the channel side of the breached levee. This will reduce erosion of the marsh over time. The footprint for the living shoreline is estimated to be approximately 95 acres.

9 Existing Real Estate Interests

Existing federal real estate interests and existing non-federal sponsor real estate interests are outlined below.

9.1 Existing Federal Real Estate Interests

The federal government has no existing interests within the project footprint. Immediately available real estate records indicate the federal government has existing interests in numerous tracts in the project vicinity (Figure 8). Many tracts were used as placement areas in the past (PA 29, PA 29-A, and PA 29-B). However, it is suspected these easements have been revoked and there are no active placement areas in the vicinity. USACE has disposed of several tracts just to the northeast of the project vicinity and west of the project vicinity.

Table 1: USACE Tracts

USACE Tract	PA Intersection	Tract Acres	Interest	Status Notes
SNWW5_79	N/A	4.65	Deed dated 23 MAY 1912	-
SNWW5_80	N/A	18.59	Deed dated 23 MAY 1912	-
SNWW5_81	N/A	4.24	Perpetual Easement dated 9 OCT 1923	-
SNWW5_86	N/A	-	Perpetual Easement dated 6 APR 1937	-
SNWW5_100E	PA 29	44	Perpetual ROW Easement dated 11 DEC 1956	-
SNWW5_101E	PA 29-A	171	Revocable Easement (after 1 year) dated 4 JUN 1948	Revoked as of 19 OCT 2006
SNWW5_102E	PA 29-A	151.24	Revocable Easement (after 1 year) dated 4 JUN 1948	Revoked as of 19 OCT 2006
SNWW5_103E	PA 29-B	80.76	Revocable Easement (after 1 year) dated 4 JUN 1948	Revoked as of 20 OCT 2003
SNWW5_104E	PA 29-B	320	Revocable Easement (after 1 year) dated 4 JUN 1948	Revoked as of 20 OCT 2003
SNWW5_105E	PA 29-B	53	Revocable Easement (after 1 year) dated 4 JUN 1948	Revoked as of 20 OCT 2003
SNWW5_106E	N/A	27	Perpetual Easement dated 8 NOV 1960	-

Table 2: USACE PAs

USACE PA	PA Acres	Interest	Status
PA 29-A	114.14	Revocable Easement (after 1 year) dated 4 JUN 1948 from SNWW5_102E	Revoked as of 19 OCT 2006
PA 29-B	151.50	Revocable Easement (after 1 year) dated 4 JUN 1948 from SNWW5_103E, 104E, and 105E	Revoked as of 20 OCT 2003

In August 2012, emergency dredging of the SNWW prompted the Port of Orange's procurement of a temporary dredge spoil easement for PAs 29-A and 29-B, allowing USACE to place material, dated August 27, 2012 that expired on August 27, 2014. There is no active USACE or Port of Orange interest on these PAs currently.

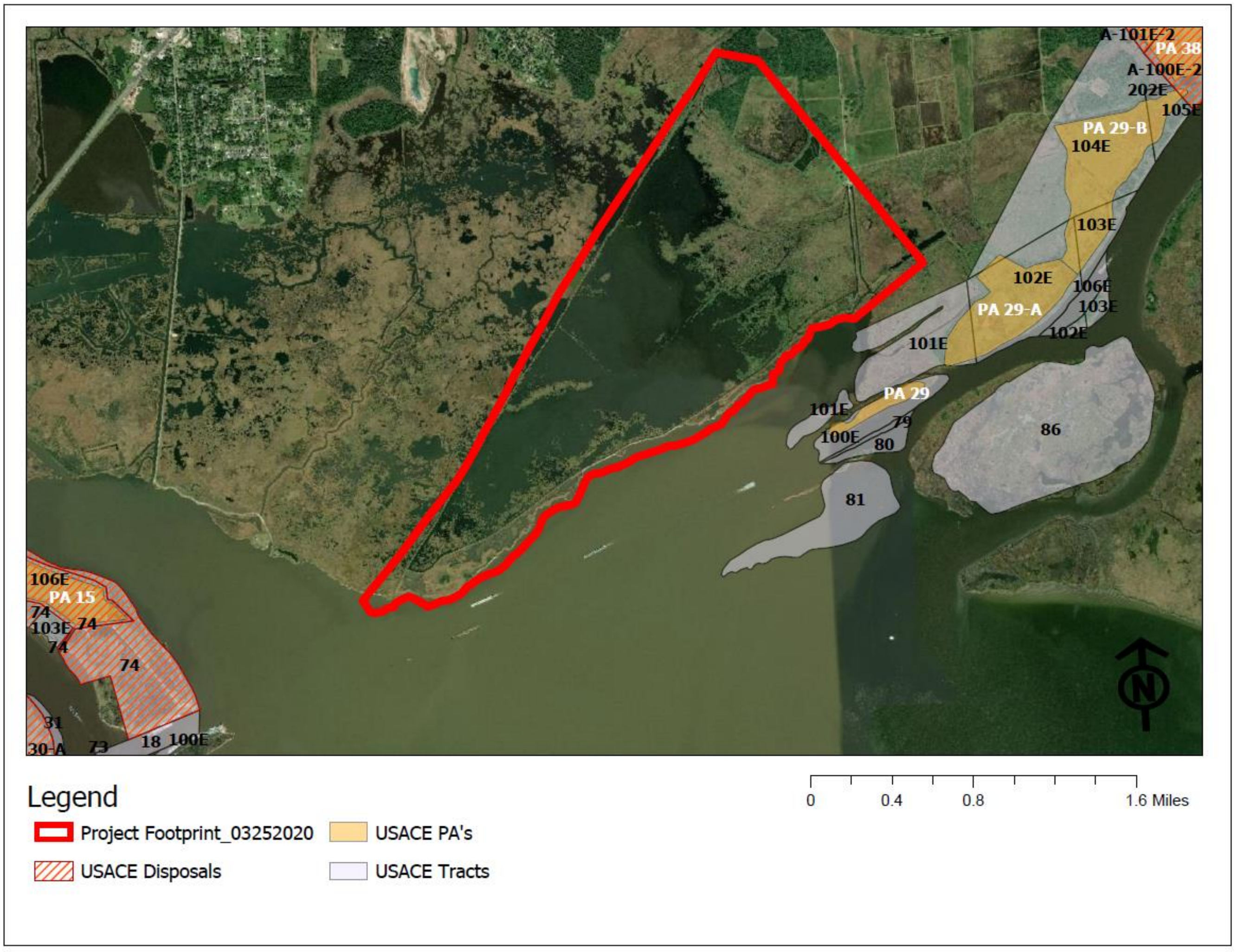

Figure 8: USACE Interests in Project Vicinity

9.2 Existing NFS Real Estate Interests

The NFS does not have any real estate interests in the project vicinity.

10 New Real Estate Requirements

The new real estate requirements for Alternative 3 are outlined below.

10.1 Alternative 3

The real estate requirements to accomplish the dredged material placement, create the living shoreline, and native species planting include the acquisition of a fixed-term easement, as described in Section 10.5.1 below, over approximately 337 acres, impacting 6 tracts and one private landowner. Specific pipeline routes to move dredged material have not yet been identified but are assumed to be submerged and not impacting any additional upland parcels. The approximately 14,623 linear foot breakwater would be constructed exclusively upon approximately 10 acres of submerged lands, therefore navigation servitude will be exercised and no acquisition will be required for this aspect of the project. The real estate requirements outlined in Table 3 below represent the widest possible footprint for consideration and are expected to be refined during the next phase of the project. This section of the REP will be updated as more information is available.

Table 3: New Real Estate Requirements for Alternative 3

Parcel ID	Total Tract Acres (per Orange County Appraisal District)	Acres Needed for 1.3 MCY Marsh Modification	Acres Needed for Existing Levee Repair	Acres Needed for Landside Access	Acres Needed for Breakwater	Acres Needed for Living Shoreline	Total Acreage (% of Total Tract)
R25748	474	76	N/A	4	N/A	N/A	80 (16.9%)
R16179	381	114	N/A	6	N/A	N/A	120 (31.5%)
R23869	105	N/A	.73	10	N/A	17	27.73 (26.4%)
R20762	716.7	N/A	.63	28	N/A	4	32.63 (4.6%)
R23002	117.8	N/A	.65	N/A	N/A	5	5.65 (4.8%)
R18038	331	N/A	1.26	N/A	N/A	70	71.26 (21.5%)
Submerged Lands	N/A	N/A	N/A	N/A	~10	N/A	N/A

10.2 Additional Increments

Should additional dredged material become available for the project, the real estate requirements for marsh modification phases 2 and 3 would include the acquisition of an additional 260 acres and 157 acres, respectively. Table 4 below outlines the anticipated new real estate requirements to construct the entire scoped project.

Table 4: New Real Estate Requirements for Additional Increments

Parcel ID	Total Tract Acres (per Orange County Appraisal District)	Acres Needed for 1.3 MCY Marsh Modification	Acres Needed for Existing Levee Repair	Acres Needed for Landside Access	Acres Needed for Breakwater	Acres Needed for Living Shoreline	Acres Needed for Marsh Modification 2	Acres Needed for Marsh Modification 3	Total Acreage (% of Total Tract)
R25748	474	76	N/A	4	N/A	N/A	118	53	251 (52.9%)
R16179	381	114	N/A	6	N/A	N/A	N/A	1	121 (31.8%)
R23869	105	N/A	.73	10	N/A	17	N/A	64	91.73 (87.4%)
R20762	716.7	N/A	.63	28	N/A	4	N/A	11	43.63 (6.1%)
R23002	117.8	N/A	.65	N/A	N/A	5	32	28	66.65 (55.7%)
R18038	331	N/A	1.26	N/A	N/A	70	70	N/A	141.26 (42.7%)
R27371	50	N/A	N/A	N/A	N/A	N/A	40	N/A	40 (80%)
Submerged Lands	N/A	N/A	N/A	N/A	~10	N/A	N/A	N/A	N/A

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10.3 Breakwater

The entirety of the breakwater footprint is on submerged lands, adjacent to the SNWW (Figure 9). The breakwater feature is approximately 14,623 linear feet. At its widest point beneath the water at the -3' contour, the breakwater is estimated to be 30' in width. At the crest elevation of +3.5' above the water, the breakwater is estimated to be 4' in width, with an anticipated slope of 2:1. The total footprint of the feature is approximately 10 acres.

While the Texas GLO manages all submerged lands 10.35 miles out into the Gulf of Mexico, the Federal Government is able to exercise navigation servitude to construct this aspect of the project. Therefore, there are no real estate requirements to construct the breakwater. This is covered further in Section 17 below.

It is a possibility that the breakwater may be constructed by a third party, Ducks Unlimited. Should Ducks Unlimited implement the breakwater feature at a later date through grant funding, the private organization would need to seek a lease from the Texas GLO to support construction and any continued operations and maintenance.

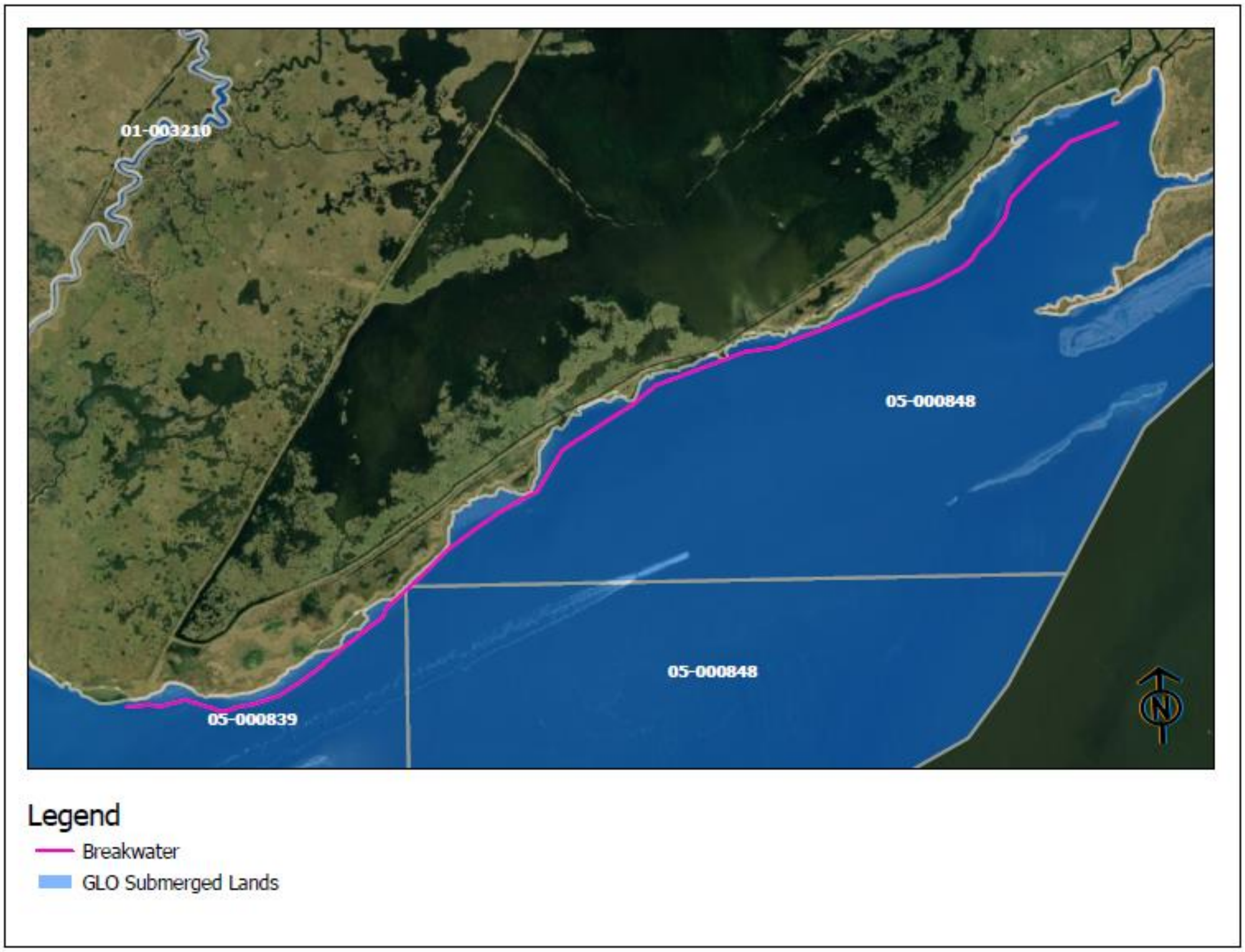

Figure 9: Breakwater Footprint

10.4 Access/Staging Areas

It is assumed that no access and/or staging areas beyond the limits of the project footprint will be required. This will be confirmed during the DI phase. At the conclusion of the DI phase, when the project reaches 95% design, determinations can be finalized and the REP will be updated to include this information, as well as the duration for any temporary work area easements (Standard Estate #15), if determined to be necessary as described in section 10.6.

10.5 Mitigation

There is no mitigation required for this project.

10.6 Estates

The NFS is responsible for securing and maintaining the minimum real estate interests required for the project. Construction of the complete project, including the breakwater and living shoreline, may require a variety of real estate interests as outlined below and in Table 5.

For the emergent and submerged lands on the privately-owned parcels, the Galveston District's Real Estate Division (CESWG-RE) is proposing the use of a non-standard, fixed-term ecosystem restoration easement to cover the placement of dredged material, planting activities, and pipeline placement to move dredged material. This is covered further in Section 10.6.1 below.

As stated in Section 10.3, navigation servitude will be exercised to construct the breakwater feature. This is covered further in Section 17 below.

Should any access/staging areas be identified outside of the limits of the project footprint, standard estate #15, Temporary Work Area Easement would apply. This easement is outlined in Section 10.6.2 below.

Table 5: Estates Required

Project Feature	Estates
Dredged Material Placement, Plantings of Native Species, Living Shoreline, Pipeline for Dredged Material, Levee Repairs on Emergent and Submerged Lands within Privately-Owned Parcels	Non-Standard Estate: Fixed-Term Ecosystem Restoration Easement
Breakwater within Submerged Lands	N/A – Navigation Servitude
Access/Staging Areas	Standard Estate #15 – Temporary Work Area Easement

10.6.1 Non-Standard Estate for Private Lands

CESWG-RE acknowledges that it is USACE policy to acquire fee simple title for ecosystem restoration projects, as fee interest ensures complete and permanent control over future use of lands and fully protects the interest of the Government. However, USACE regulations also indicate that a lesser interest, such as a specific type of easement, may be appropriate depending on the operational requirements of the project and other circumstances relevant to project implementation, including landowner preference (EP 1165-2-502, Paragraph 17b. and ER 405-1-12-9, Paragraph a(6)). CESWG-RE proposes the acquisition of a Non-Standard Fixed Term Ecosystem Restoration Easement in lieu of fee for this pilot program Project.

This project involves the beneficial use placement of dredged material sourced from SNWW. The life of the project, for period of analysis purposes, is considered to be 50 years. A timeline for work on the tracts cannot be developed at this time, as the waterways targeted for material are not regularly dredged and are not on the schedule for work plan funding per the Operations Division.

Once the dredged material is placed and final plantings are completed, activities on the project lands will cease. No future operations and maintenance (O&M) is planned for the project. Environmental monitoring will continue for 10 years as required by Section 1161 of WRDA 2016. The project is expected to be self-sustaining. Therefore, it is the opinion of the PDT that acquisition of fee title is not necessary to accomplish the construction and operation and maintenance of the project, and that those requirements can be accomplished through the acquisition of a fixed-term ecosystem restoration easement which clearly defines the rights needed for the project and which sustains the Federal investment. The non-standard estate will propose termination of the fixed-term easement at 10 years post-construction or upon the Project's deauthorization.

At the time of this report, the non-standard estate is continuing to be refined at the District and is expected to be routed by separate request to USACE Headquarters (HQUSACE). Real estate has worked closely with the NFS on drafting the non-standard estate. Additionally, the NFS has engaged the landowner in discussions to ensure the language presented for approval to HQUSACE will be acceptable to the landowner upon project implementation. The latest draft of the granting clause appears below.

> *DRAFT Non-Standard Estate: Fixed Term Ecosystem Restoration Easement*
>
> *An assignable right, servitude, and ecosystem restoration easement in, on, over and across the lands of the Grantors described in Exhibit A [Tract Nos. ____, ______, _____], attached hereto, for a period not to exceed ten (10) years to construct, operate, maintain, repair, alter, rehabilitate, remove, replace and monitor features of the HICKORY COVE MARSH RESTORATION & LIVING SHORELINE PROJECT, BRIDGE CITY, TX. In the event the Project is de-authorized by the federal government, this Easement and all rights granted hereunder shall terminate.*
>
> *The Grantee shall have the right to construct, operate, maintain, repair, replace, rehabilitate, monitor, and adaptively manage the Project on the Property, which rights shall include the right to: (a) excavate and deposit dredged material, sediment, and/or other beneficial materials on the Property; (b) accomplish any alterations or contours on the Property to accommodate the materials deposited on the Property in connection with the Project and to perform necessary work for the prevention or remediation of damages to marsh, wetlands, habitat restoration, or other natural values; (c) install, construct, store, alter, maintain, repair, replace, relocate, and remove dikes, berms, fencing, monitoring devices, equipment, supplies, materials, warning or informational signs, notices, markers and other similar items related to the Project; (d) conduct surveys, borings, inspections, investigations, monitoring, adaptive management practices, and similar activities to evaluate the effectiveness of the Project, and/or to enhance, extend, periodically replenish and maintain the material deposited or placed on the Property, and/or to determine if the Grantor, or its successors, heirs, and assigns are complying with the covenants and prohibitions contained in this Easement; (e) plant, cause the growth of, nourish, replenish, manage, and maintain vegetation and control or remove invasive species; together with the right to remove structures or obstructions including levees; reserving, however, to the owners, their heirs and assigns, all other rights and privileges that may be used without interfering with or abridging the enumerated rights and easement hereby conveyed and acquired; all subject to existing easements for public roads and highways, public utilities, railroads and pipelines.*

At the request of the landowner, it is expected the final easement will also include language requiring notification prior to work and language expressing that, if at all possible, work will avoid the months of November through February to minimize disturbance to wintering waterfowl. These requests were reviewed and approved by the PDT. The Operations Division concurred and added that the timing of funding, as well as the District's ability to dictate Order of Work, could likely accommodate the request with minimal disturbance during the month of November.

At the time of this report, the project's DI schedule aims for real estate certification in February 2023. Timely approval of a non-standard estate stipulating less than fee interest is an implementation risk to the project. Without approval, the lands required for the construction of the project will not be acquired.

10.6.2 Standard Estate

Standard Estate #15 – Temporary Work Area Easement

> *A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____), for a period not to exceed___________________, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the ___________________ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.*

11 Borrow Material

All material necessary for the project will be obtained during normal maintenance cycles or from new work construction from the SNWW. The intention of Section 1122 pilot program is to beneficially utilize dredged material, therefore no additional sources of borrow are planned.

This area is not regularly dredged. As such, implementation of the project is dependent on the Operations Division receiving workplan funding. The Operations Division has requested workplan funding for this project in FY2023, but no schedule for the proposed dredging and marsh restoration has been prepared at this time. Once a schedule for dredging has been prepared, Real Estate will create a table outlining the contract, dredge locations, volumes, and tracts impacted.

12 Recreation Features

There are no recreation features proposed for this project.

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13 Timber Rights and Mineral/Energy Activity

There is no known timber activity within the project area.

Oil and gas exploration and production activities are prevalent in the southeast Texas area. Figure 10 shows the wells and pipelines in the study area. The project footprint overlaps the location of three buried pipelines and one well.

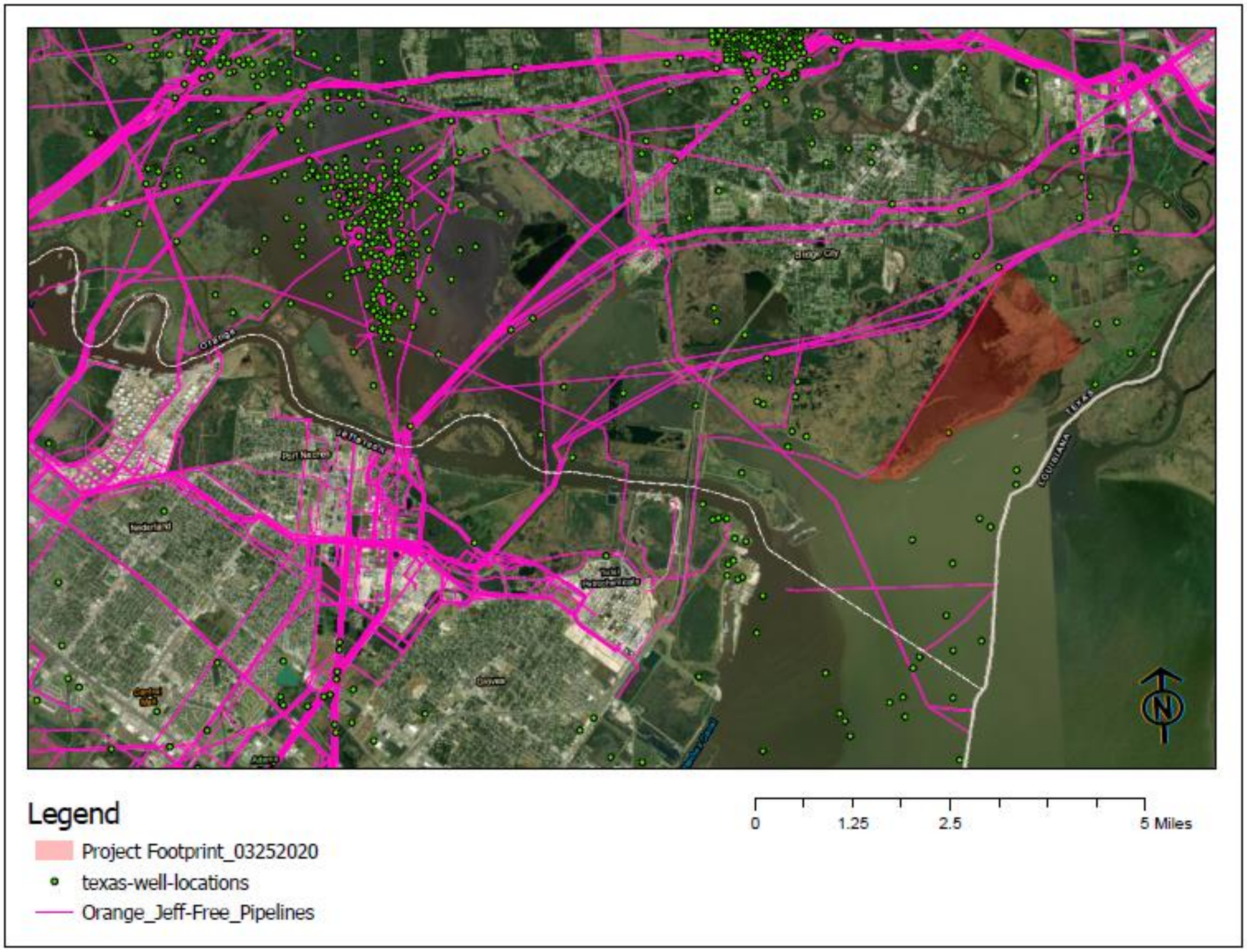

Figure 10: Mineral Activity in the Study Area

Parcel ID R18038 contains a well that is an inactive dry-hole on the northeast portion of the tract along the western boundary of Parcel ID 23002 (Figure 11). Pipeline activity is discussed further in Section 14 below. With respect to the well activity, this area of Texas was heavily exploited in the past and minimal further exploration is anticipated. A search of deed records confirms the warranty deed conveyance of the properties was completed subject to all valid and subsisting mineral conveyances. A search of the Railroad Commission of Texas records did not produce any documentation for the American Petroleum Institute (API) number 36130452. It is the opinion of the landowner that the well has been abandoned. From an ecosystem restoration viewpoint, the PDT believes the acquisition of mineral rights for the sole purpose of protecting the project is not justified.

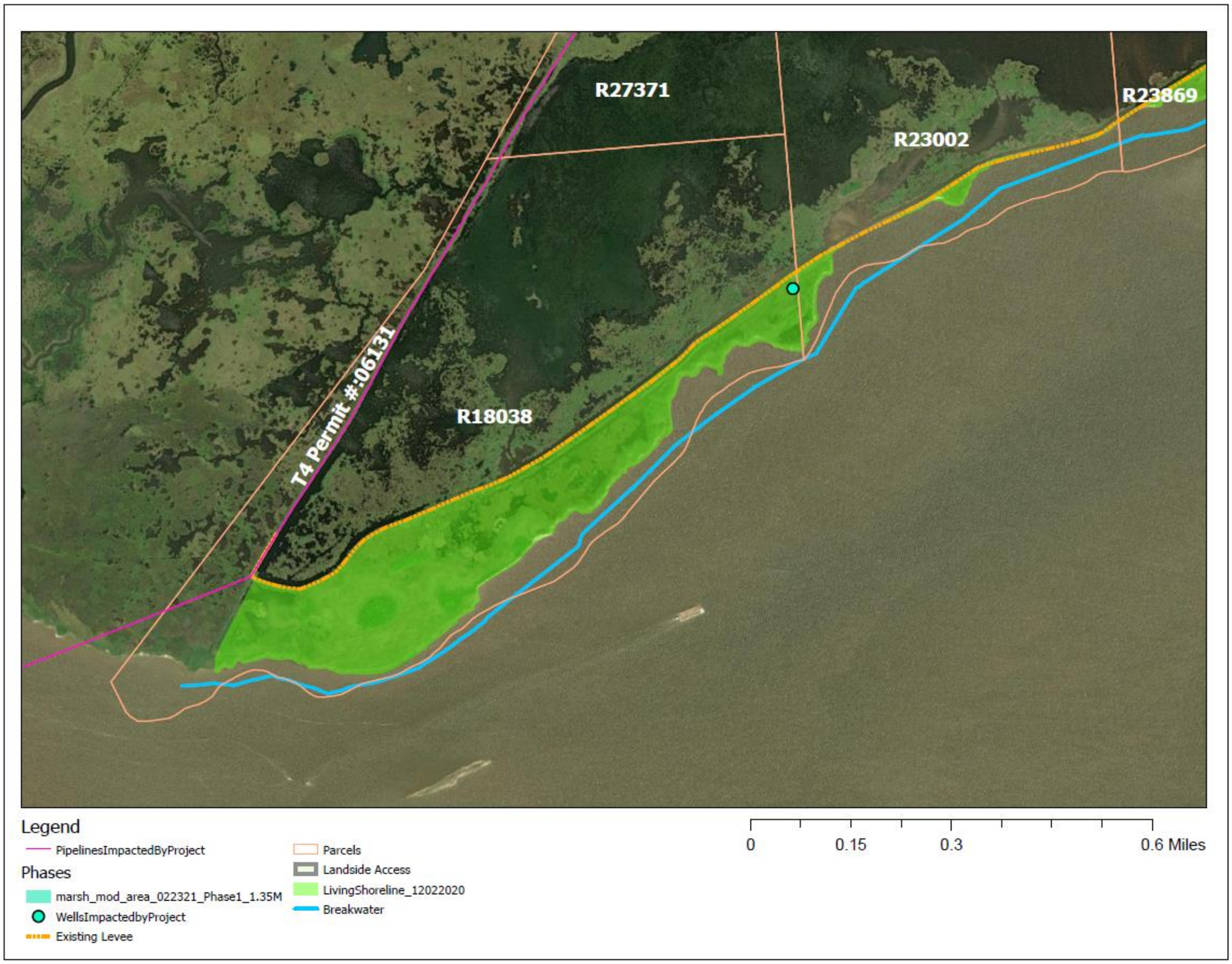

Figure 11: Well in Project Area

At this time, there are no expected impacts to the oil and gas industry during the restoration of the marsh or planting activities. It is expected the ecosystem restoration efforts, such as marsh elevation development, removal of invasive species, and planting of native species can be conducted to avoid impacting subsurface rights and the inactive well within the proposed project footprint. The placement of dredged material to the target fill is not expected to impact the buried pipeline running along the very northern edge of the project alignment. It is likely the pipeline can be avoided in its entirety. Repairs and maintenance to the well could potentially disrupt project features. However, mitigating solutions can be addressed in the Section 408 review process.

Any third-party request to conduct work on USACE project lands will be subject to the Section 408 review process, giving USACE the additional opportunity to ensure the project continues to provide its intended benefit. Approval through Section 408 could include the requirement that, after completing maintenance, the well or pipeline owner is required to restore the project to its pre-maintenance condition.

Additional research will be conducted throughout the remainder of the feasibility phase, as well as continuing through the DI phase to confirm ownership of the wells and investigate the current rights of the well owner and pipeline owner impacted by the project. Coordination between USACE Engineering, Environmental, and Real Estate teams, as well as the NFS, landowner, well owner, and pipeline owner will be required. As discussions with all parties continue regarding the project features and requirements, responsibilities will be agreed upon and this section of the REP will be revised to reflect those agreements.

14 Facility/Utility/Pipeline Relocations

The project footprint minimally overlaps one buried pipeline on the very northern edge of the project footprint (Table 6 and Figure 12). The pipeline runs along the westernmost edges of six parcels: R18038, R27371, R25748, R16179, R25748, and R20762. A copy of the pipeline easement was reviewed by SWG Real Estate. The private owner granted a non-exclusive easement 30' in width (15' on either side of the centerline). The Right of Way and Easement document

> *"assigns a Right of Way and Easement, to operate, maintain, inspect, repair, replace, change the size of, and remove, in whole or in part a eight inch (8") pipeline for the transportation of oil, gas, other liquid or gaseous hydrocarbons, including any products thereof, water and other materials, a communications cable (said communications cable having its only purpose and function as being an appurtenance to the pipeline) and such other equipment and appurtenances as may be necessary or incidental for such operations (hereinafter referred to collectively as "the pipeline") including, but not limited to, the right to construct, operate and maintain cathodic protection units and necessary equipment upon, over and through"* the tracts.

The grantee has reasonable rights of ingress and egress as well as the right to cut and keep clear all trees, brush, and other obstructions that may endanger the safe operation of the pipeline. The pipeline was to be buried at a "sufficient depth so as not to interfere with the cultivation of the soil." The easement is set to terminate in July 2026, but the Grantee has the right and options to extend up to the year 2101.

Table 6: Pipeline in Project Footprint

Pipeline Operator	T4 Permit #	Diameter (In.)	Commodity	Status	Notes
Enterprise Product Solutions (previously Sabine Pipeline LLC)	06131	8.63	Propylene	In Service	Impacting westernmost edges of parcels R18038, R27371, R25748, R16179, R25748, and R20762.

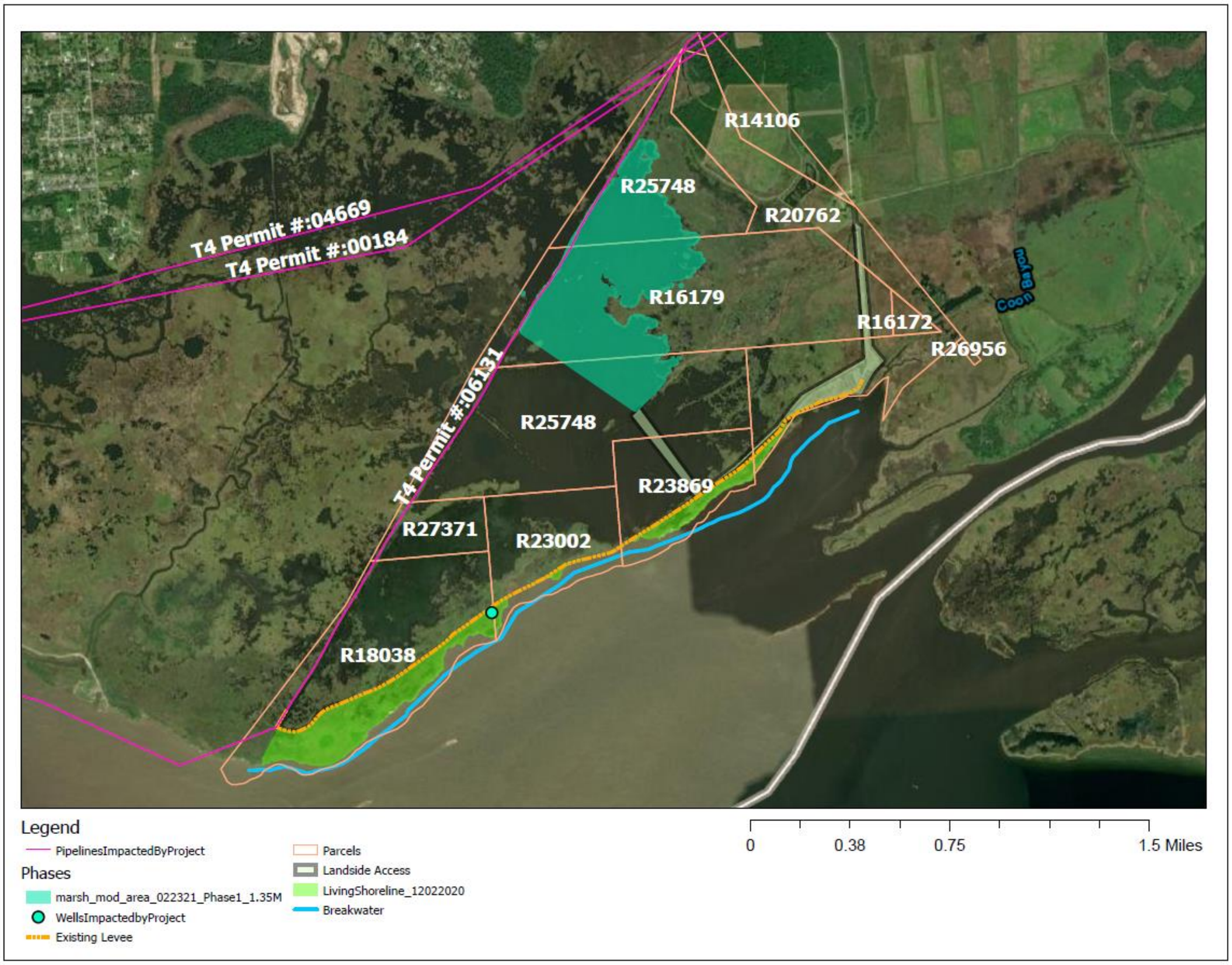

Figure 12: Pipeline in the Project Area

ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REPORT THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, AND MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES.

15 Zoning

Zoning ordinances will not be enacted to facilitate acquisition for the proposed project.

16 Hazardous, Toxic, and Radioactive Waste or Other Environmental Contaminants

No sites were found that had recognized HTRW environmental conditions.

17 Navigation Servitude

Navigation Servitude stems from the Commerce Clause of the Constitution of the United States (U.S. CONST. art.I, Sec.8, cl.3), and is defined as the dominant right of the Federal Government to use, control, and regulate the navigable waters of the United States and submerged lands thereunder for various commerce-related purposes including navigation and flood control. In tidal areas, the servitude extends to all lands below the mean high-water mark, whereas in non-tidal areas, the servitude extends to all lands within the bed and banks of a navigable stream that lie below the ordinary high-water mark.

The breakwater feature, as depicted in Figure 9, will be constructed under navigation servitude.

18 Induced Flooding

There will be no induced flooding by virtue of the construction of the project.

19 Attitudes of the Landowner

No public meeting was held. There is one private landowner impacted directly by the project footprint. The landowner attended the project kick-off meeting to express support, given the disappearance of the marsh and bird habitat during his period of ownership. The landowner has been briefed throughout the project by the NFS. The landowner remains supportive of the project, pending final easement discussions. It is expected reactions to the project from neighboring landowners and residents will be positive.

20 Public Law 91-646 Relocations

There are no residential, commercial, industrial, or farm properties that would be subject to relocation pursuant to Public Law (PL) 91-646.

21 Real Estate Costs

Total project costs for the recommended plan are estimated to be at least $38 million. Pursuant to Policy Guidance Letter (PGL) 31 dated 11 January 2019, "for projects in which the value of real estate (lands, improvements, and severance damages) are not expected to exceed 15% of total project costs (total costs to implement project), a cost estimate (or rough order of magnitude) will be acceptable for purposes of the feasibility phase." As such, the land cost listed in Table 7 below is based on a rough order of magnitude (ROM) cost estimate. Data to form the cost estimate originated from the Orange County Appraisal District, as well as a gross appraisal performed on similar marsh lands in the vicinity. The Orange County Appraisal District lists the market value of the land to be $250 per acre. A gross appraisal completed by the USACE on similar lands just south of the project area valued marshland at $400 per acre for fee value. Even at the highest estimate per acre, land costs are not anticipated to exceed 15% of the total project cost.

The baseline cost estimate (BCE) provided in this report is based on feasibility-level design. The BCE lacks estimates for anticipated condemnation expenses due to the NFS stance on condemnation for this project. In order to account for the additional risk present when determining real estate requirements for the TSP-level design, a 25% contingency has been included in table below. The BCE is subject to change through the final draft.

Table 7: Baseline Cost Estimate (BCE) for Real Estate

Account	Description	Alternative 3 - 1.3 mcy, Living Shoreline, and Breakwater
01	Acquisitions Labor (4 hrs. x $150/hr per tract)	$ 6,000.00
01	Appraisals ($2,000 per tract)	$ 20,000.00
01	Survey ($2,000 per tract)	$ 20,000.00
01	Temporary work easements, ROW, Permits, License ($500 per owner)	$ -
01	Project Related Administration (10 hrs. x $150 per hr. per tract)	$ 15,000.00
01	Land Cost	$ 60,621.48
01	LERRD Crediting Administrative Costs ($500 per tract)	$ 5,000.00
01	Title Policy ($300 per tract)	$ 3,000.00
	Total Admin and Payments	**$ 129,621.48**
	Contingencies (25%)	**$ 32,405.37**
	Non-Federal Total	**$ 162,026.85**
01	Acquisitions (Review RE Planning Documents & Mapping at 5 hrs. x $125 per hour per tract)	$ 6,250.00
01	Appraisal Reviews (8 hrs. x $125 per hour per tract)	$ 10,000.00
01	LERRD Crediting and Real Estate Certification (4 hours x $150 per hour per tract)	$ 6,000.00
01	Project Related Administration (5 hrs. x $125 per hour per tract)	$ 6,250.00
	Total Admin and Payments	**$ 28,500.00**
	Contingencies (25%)	**$ 7,125.00**
	Federal Total	**$ 35,625.00**
	GRAND TOTAL	**$ 197,651.85**

There are no costs associated with the 02 Relocations account.

22 Acquisition Schedule

The proposed plan is to acquire a term-limited easement on six privately owned real estate tracts totaling 337 acres from one, willing landowner. Timeline for implementation of this project is heavily dependent upon the Operations Division receiving workplan funding for dredging in the area. As such, the acquisition schedule below is based not only on the signing of the PPA, but also the confirmation of workplan funding. The acquisition schedule below outlines the milestones and approximate durations for the acquisition of LERRD for this project, which can be expected to be completed within one year (Table 8). The durations shown below are the estimated average durations, however milestones may move quicker if preceding tasks are completed sooner than expected. It should be noted that each individual tract acquisition can and should move along the acquisition schedule independently of the other tracts. The acquisition schedule does not include timelines for condemnations, as the sponsor is unwilling to condemn for the project.

Table 8: Land Acquisition Schedule

Milestone	Predecessor	Average Duration
Transmittal of ROW drawings and instruction to proceed with acquisition along with required estate(s)	Immediately after PPA signed	30 days
Obtain Surveys	Upon transmittal of ROW drawings and instruction to proceed with acquisition	60 days
Obtain Title Evidence	Upon completion of surveys	60 days
Obtain Appraisals & Reviews	Upon obtaining title evidence	60 days
Authorization to Proceed with Offer	Upon obtaining appraisals & reviews	30 days
Conclude Negotiations	Upon obtaining authorization to proceed with offer	60 days
Conduct Closings	Upon concluding negotiations	30 days
NFS Attorney Certifies Availability of LERRD	Upon conclusion of closings	30 days
Corps Certifies Availability of LERRD	Upon Attorney Certification of LERRD	30 days
Review LERRD Credit Request	Upon completion of the project and NFS submission of LERRD documentation	60 days
Approve or Deny LERRD Credit Requests	Upon conclusion of review of LERRD Credit Request	15 days

23 Other Real Estate Issues

There are no additional real estate concerns at this time.

24 References

2020. Orange County Appraisal District. Online GIS Viewer.

2020. Railroad Commission of Texas. Online GIS Viewer.

2020. Texas General Land Office. Online GIS Viewer.

Exhibit A

Assessment of NFS Acquisition Capabilities

DEPARTMENT OF THE ARMY
U. S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

HICKORY COVE MARSH RESTORATION & LIVING SHORELINE
BRIDGE CITY, TEXAS
ORANGE COUNTY NAVIGATION & PORT DISTRICT (PORT OF ORANGE) – NON FEDERAL SPONSOR

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

I. Legal Authority:

a. **Does the sponsor have legal authority to acquire and hold title to real property for project purposes? (yes/no; If yes, please cite or attach authority.)**

Yes. Please see attached legal opinion and related attachments.

b. **Does the sponsor have the power of eminent domain for this project? (yes/no; If yes, please cite or attach authority.)**

Yes, per the Texas Constitution, Article 16, Section 59. See related attachments.

c. **Does the sponsor have "quick-take" authority for this project? (yes/no; If yes, please cite or attach authority.)**

Yes. Please see attached legal opinion and related attachments.

d. **Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? (yes/no; If yes, please explain.)**

No. All property considered for this project is located within Orange County.

e. **Are any of the lands/interests in lands required for the project unable to be condemned by the sponsor? (yes/no; If yes, please explain.)**

The Port is unable to condemn state lands

f. **Is the sponsor willing to acquire lands for the project, even if eminent domain or quick-take are required? (yes/no; If no, please explain)**

No. The Port is willing to approach the landowner with a term-limited easement, but is unwilling to exercise eminent domain or quick-take authority. The landowner is willing to take the dredge spoil for this project, pending easement discussions.

II. Human Resource Requirements:

a. **Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including Public Law 91-646 (Home Relocation Assistance), as amended? (yes/no)**

Yes.

b. **If the answer to II.a. is "yes," has a reasonable plan been developed to provide such training? (yes/no)**

Yes.

c. **Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? (yes/no)**

Yes.

d. **Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? (yes/no)**

Yes.

e. **Can the sponsor obtain contractor support, if required in a timely fashion? (yes/no)**

Yes.

f. **Will the sponsor likely request USACE assistance in acquiring real estate? (yes/no; if yes, please explain.)**

No.

III. <u>Other Project Variables</u>:

a. **Will the sponsor's staff be located within reasonable proximity to the project site? (yes/no)**

Yes.

b. **Has the sponsor approved the project/real estate schedule/milestones? (yes/no)**

Yes. SWG's Real Estate staff and the Port are working together to establish the schedule and milestones for this project.

IV. <u>Overall Assessment</u>:

a. **Has the sponsor performed satisfactorily on other USACE projects? (yes/no/not applicable)**

Yes.

b. **With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/ insufficiently capable. (If sponsor is believed to be "insufficiently capable," provide explanation.)**

Fully capable.

V. Coordination:

a. **Has this assessment been coordinated with the sponsor? (yes/no)**

Yes.

b. **Does the sponsor concur with this assessment? (yes/no)**

Yes.

Accepted by the Non-Federal Sponsor:

Louie Taylor

(Signature)

Executive Port Director/CEO

(Title)

6/25/20

(Date)

Prepared by:

SCHLUND.NICHOLE.1272245082 Digitally signed by SCHLUND.NICHOLE.1272245082 Date: 2020.06.23 16:03:42 -05'00'

Nichole L. Schlund
Realty Specialist
Real Estate Division
Galveston District
U.S. Army Corps of Engineers

Reviewed by:

Brian Murphy
Chief, Acquisition and Realty Services Branch
Real Estate Division
Galveston District
U.S. Army Corps of Engineers

Approved by:

Timothy J. Nelson
Chief, Real Estate Division
Galveston District
U.S. Army Corps of Engineers

Exhibit B

Risk Letter

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1229
GALVESTON, TEXAS 77553-1229

01 May 2020

Ms. Lorrie Taylor
Executive Port Director/CEO
Port of Orange
1201 Childers Road Suite #2
Orange, TX 77631

Dear Ms. Taylor:

The intent of this letter is to formally advise the Port of Orange, as a potential Non-Federal Sponsor for the proposed Hickory Cove Marsh Restoration & Living Shoreline project, of the risks associated with land acquisition prior to the execution of a Project Partnership Agreement (PPA) or prior to the Government's formal notice to proceed with acquisition. If a Non-Federal Sponsor deems it necessary to commence acquisition prior to an executed PPA for whatever reason, the Non-Federal Sponsor assumes full and sole responsibility for any and all costs, responsibility, or liability arising out of the acquisition effort.

Generally, these risks include, but may be not be limited to, the following:

a. Congress may not appropriate funds to construct the proposed project;

b. The proposed project may otherwise not be funded or approved for construction;

c. A PPA mutually agreeable to the Non-Federal Sponsor and the Government may not be executed and implemented;

d. The Non-Federal Sponsor may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended;

e. The Non-Federal Sponsor may acquire interests or estates that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project;

f. The Non-Federal Sponsor may initially acquire insufficient or excessive real property acreage which may result in additional negotiations and/or benefit payments under P.L. 91-646 as well as the payment of additional fair market value to affected landowners which could have been avoided by delaying acquisition until after PPA execution and the Government's notice to commence acquisition and performance of providing lands, easements, rights-of-way, relocations, and disposals (LERRD);

g. The Non-Federal Sponsor may incur costs or expenses in connection with its decision to acquire or perform LERRD in advance of the executed PPA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662 or the PCA as referenced in *ER 405-1-12 (Change 31; 1 May 98) Section 12-31 Acquisition Prior to PCA Execution.*

For any questions, please contact Nichole Schlund, Realty Specialist within the Galveston District Real Estate Division, at Nichole.L.Schlund@usace.army.mil or 409-766-3146.

Sincerely,

NELSON.TIMOTHY.J.1230372922

Timothy Nelson
Chief, Real Estate Division
Galveston District
U.S. Army Corps of Engineers

Hickory Cove Marsh Restoration And Living Shoreline

Bridge City, TX

WRDA 2016 Section 1122

Beneficial Use of Dredged Material

Appendix D: Cost

U.S. Army Corps of Engineers

Southwest Division

Galveston District

Cost Summary

This MII ver 4.4 estimate was developed for the Section 1122 Study for Hickory Cove Marsh. The marsh is located within Hickory Cove Bay and is located adjacent to the Sabine River and the northern end of Sabine Lake. The primary focus of the study is 677.31 acres of marsh to be restored from open water to freshwater marsh habitat. The study was conducted under the authority of Section 1122 of the Water Resources Development Act (WRDA) of 2016 and requires USACE to pursue pilot demonstrations of the beneficial use of dredged material.

This estimate was prepared using the latest Unit Price Books and labor rates for fiscal year 2022 (October 2021). The Mii was developed using the work breakdown structure. The midpoint date of each account code was used to develop the fully funded costs. The estimate was prepared in accordance with ER 1110-2-1302. The estimates were based on standard operating practices for the Galveston District which assumed conventional contracting practices of large business IFB's.

An Abbreviated (Informal) Risk Analysis (ARA) was developed with the participation of the PDT. The results were used to develop the project contingences. The contingencies along with the estimates were input into the Total Project Cost Summary Sheet (TPCS). The costs were escalated in accordance with the Engineering Regulation and EM 1110-2-1304 to mid-point of construction.

Initially four alternatives were considered. The alternatives were as follows:

No Action (Federal Standard): Since there is no DMMP in effect, the base plan was identified as the most recent, and therefore most likely future placement site for dredge material in the absence of a BU effort. The most recent dredging of the SNWW was an emergency action in 2012 and used Placement areas 29A and 29 B for material disposal. The establish the incremental cost, the PDT assessed the cost of disposal from this dredge cycle at Placement areas 29 A/B. Hickory Cove Marsh was designated to be the Federal Standard with continued placement of dredge material into placement areas 29A/B.

Alternative 1c: Restoring marsh to a target elevation using dredged material and restoring existing breached containment levee.

Alternative 2: In addition to Alternative 1, includes construction of a 14,623 LF detached breakwater to armor the shoreline along the SNWW/GIWW.

Alternative 3: This alternative takes Alternative 2 and plants a living shoreline on the exterior side of the containment levee. Southwest Division (SWD) directed the Project Delivery Team to go with alternative 3.

The result of the Class 4 estimate is listed in Table 1 below.

Table 1

Summary of Preliminary Cost w/ Contingency
By Code of Account
FY 2022 Price Level

Code of Accounts	Federal Standard PA 29A/B-1.3MCY	*Alt 1c - 1.35MCY*	*Alt 2 - 1.35 MCY + Breakwater*	*Alt 3 - 1.35 MCY + Living Shoreline+ Breakwater*
NON-FEDERAL COSTS				
01 Lands and Damages	33,803	106,152	106,152	161,000
Total Non-Fed	33,803	106,152	106,152	161,000
FEDERAL COSTS				
01 Lands and Damages	7,125	21,375	21,375	36,000
06 Fish & Wildlife Facilitates		2,257,000	2,257,000	2,257,000
06 Living shoreline				2,442,000
10 Breakwater and Seawall			19,468,000	19,468,000
12 PA work	19,584,500			
12 Dredging	16,820,479	10,906,000	10,906,000	10,906,000
30 Planning, E&D	3,775,196	1,365,003	3,383,835	3,637,070
31 Const Mngt	2,912,398	1,053,040	2,610,480	2,805,840
Total Fed	$ 43,099,698	$ 15,602,418	$ 38,646,690	$ 41,551,910
TOTAL PROJECT COST:	**$ 43,133,501**	**$ 15,708,570**	**$ 38,752,842**	**$ 41,712,910**
TOTAL PROJ CST (rounded)	**$ 43,134,000**	**$ 15,709,000**	**$ 38,753,000**	**$ 41,713,000**

ACCOUNT CODE 01 - LANDS AND DAMAGES: The Galveston District Real Estate Division developed costs for Lands and Damages.

ACCOUNT CODE 06 – FISH AND WILDLIFE FACILITIES: Water Resource Section of the Hydraulics & Hydrology Branch provided all the quantities associate with this account. The cost was based on similar work done by the district. There are two separate items under this account. The first item is marsh creation which includes moving the dredge pipeline around to create the marsh, training berm, returning at later date, and input a circulation channel. The second item is the creation of the living shoreline. This involves planting 217,000 plants along the exterior of containment levee.

ACCOUNT CODE 10 – BREAKWATER AND SEAWALL: Water Resource Section of the Hydraulics & Hydrology Branch provided all the quantities associate with this account. Costs in this account code include all labor, equipment, and material costs to procure and install blanket stone, riprap, and geotextile. It was assumed the contractor would need to dredge an access channel to place the riprap. The cost was based on similar work done by the district

ACCOUNT CODE 12 – NAVIGATION PORTS AND HARBORS: The Water Resource Section of the Hydraulics & Hydrology Branch in conjunction with Operation Division provided the quantities associate with this account. The dredging will only occur with a maintenance dredge contract. It was assumed that a 24" pipeline dredging would dredge material from Sabine River and place it into the marsh. The dredging will only occur if there was a maintenance dredge contract occurring at the time. The dredging cost was developed using CEDEP and based on standard operating practices for the Galveston District.

ACCOUNT CODE 30 – PLANNING, ENGINEERING AND DESIGN: The cost for this account code was developed using a percentage of the construction work and in coordination with the PM/PDT.

ACCOUNT CODE 31 - CONSTRUCTION MANAGEMENT: Costs for this account code was developed using a percentage of the construction work and in coordination with the PM/PDT.

Hickory Cove Marsh Restoration And Living Shoreline

Bridge City, TX

WRDA 2016 Section 1122

Beneficial Use of Dredged Material

Appendix E: Cost Effectiveness and Incremental Cost Analysis

U.S. Army Corps of Engineers

Southwest Division

Galveston District

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List of Acronyms

AAHU	Average Annual Habitat Unit
CE/ICA	Cost Effectiveness / Incremental Cost Analysis
EGM	Economic Guidance Memorandum
ICA	Incremental Cost Analysis
IDC	Interest During Construction
NER	National Ecosystem Restoration
OMRR&R	Operations, Maintenance, Repair, Replacement, and Rehabilitation

1 Introduction

Comparing benefits and costs for ecosystem restoration provides a challenge to planners and decision makers because benefits and costs are not measured in the same units. Environmental restoration benefits can be measured in habitat units or some other physical unit, while costs are measured in dollars. Therefore, benefits and costs cannot be directly compared. Two analyses are conducted to help planners and decision makers identify plans for implementation, though the analyses themselves do not identify a single ideal plan. These two techniques are cost effectiveness and incremental cost analysis. Use of these techniques are described in the Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies (U.S. Water Resources Council 1983).

Cost effectiveness compares the annual costs and benefits of plans under consideration to identify the least cost plan alternative for each possible level of environmental output, and for any level of investment, the maximum level of output is identified.

Incremental cost analysis of the cost-effective plans is conducted to reveal changes in costs as output levels are increased. Results from both analyses are presented graphically to help planners and decision makers select plans. For each of the best buy plans identified through incremental cost analysis, an “is it worth it?” analysis is then conducted for each incremental measure or plan to justify the incremental cost per unit of output to arrive at a recommended plan.

As this appendix will document, the National Ecosystem Restoration Plan identified as the Tentatively Selected Plan, is Alternative 3 which comprises marsh creation, a breakwater structure, and a restored living shoreline feature. For this study, the environmental outputs are average annual habitat unit (AAHU), which are the product of a Habitat Suitability Index and an alternatives acreage analysis. The development of the AAHUs is discussed in detail in Appendix B-6—Ecological Modeling.

2 Measures and Alternatives

2.1 Measures

A measure is defined as a means to an end; an act, step, or procedure designed for the accomplishment of an objective. In other words, a measure is a feature (structure), or an activity, that can be implemented at a specific geographic site to address one or more planning objectives. Measures are the building blocks of alternatives and are categorized as structural and non-structural. Equal consideration was given to measures during the planning process while conducting this feasibility study. A detailed description of each of these can be read in the Main Report Chapter 3.9.

- **Dredge Material Placement/Marsh Creation**
- **Breakwaters**
- **Living Shorelines**

2.2 Alternatives

The array of management measures was combined into alternatives that would address ecosystem restoration of the coastal habitats, as well as restore structure and function of the study area. Each of the alternatives listed below could be a standalone plan or be combined with other alternatives to form a suite of plans.

In the subsequent sections, only the 1.3 million cubic yard scale of Alternate 1 is carried forward for comparison of Alternatives 2 and 3. The team identified the sediment volume as a source of uncertainty in the analysis, due to either variable coastal conditions, budget allocation decisions at the District, and corresponding cost share capabilities of the Non-Federal Sponsor. The scales of sediment placement were assessed to confirm that, should smaller placements be necessary based on the conditions noted above, the varied scales of sediment placement were justified. Based upon Vatical Team guidance at an In Progress Review, it concurred with the PDT explanation that the largest sediment volume should be considered in combination with other measures to assess Alternatives 2 and 3.

3 Average Annual Habitat Units and Costs

In order to determine benefits of an environmental restoration plan, future with-project environmental outputs are compared to future without-project outputs. The difference between the two represents the benefits from project implementation. The Average Annual Habitat Units (AAHUs) were calculated using the Annualizer Tool in the Institute for Water Resources Planning Suite II. Appendix B-6 – Ecological Modeling provides further documentation on how AAHUs were calculated for each Future-Without Project (FWOP) and Future-With Project (FWP) condition benefits.

3.1 Existing and Future-Without Project Average Annual Habitat Units

For this study, FWOP baseline conditions are assumed to be the same as existing conditions, given the existing habitat quality. Future-Without Project conditions were estimated by a team of biologists, including representatives from USACE, Bridge City TX, and State of Texas resource agency representatives.

3.2 Future-With Project Average Annual Habitat Units

Environmental restoration benefits are calculated by subtracting the FWOP AAHU from the FWP AAHU. For the comparison of measures, both environmental outputs and costs were annualized over a 50-year planning horizon using the FY 2021 Federal Discount Rate of 2.5% (per EGM 20-01 dated 31 October 2020). The 50-year planning horizon is used primarily for analytical purposes pertaining to the benefit-cost calculations; actual benefits may well indeed be realized longer than 50 years and any discussion of such longer-term benefitting would be found in Appendix B-6 – Ecological Modeling.

The resulting benefits are then used, along with annual costs, to identify cost effective plans and perform incremental cost analysis. The calculation of benefits (outputs/AAHUs) are shown in

.

	Alternatives	AAHU Benefits
Hickory Cove Marsh	ALT 1A—500K CY of Marsh Creation	70.5
	ALT 1B—900K CY of Marsh Creation	78.5
	ALT 1C—1.3M CY of Marsh Creation	87.3
	ALT 2—1.3M CY of Marsh Creation + Breakwater	256.4
	ALT 3—1.3M CY of Marsh Creation + Breakwater + Living Shoreline	291.5

3.3 Costs

Total project economic costs were annualized using the Annualizer Tool in Institute for Water Resources (IWR) Planning Suite II. A period of analysis of 50 years was used, along with a Federal Discount rate of 2.5% (per EGM 20-01 dated 31 October 2020). Cost estimates are expressed in October 2020 dollars/price-level.

Cost estimates provided throughout the remainder of this appendix exclude the costs related to dredging activities that would occur independently of these ecosystem restoration features. Finally, no type of monitoring nor operation & maintenance is attached to this project; details to explain such to be found in the main report and/or the Appendix B-6 – Ecological Modeling.

provides a summary of total and annualized plan costs. Construction durations were estimated to be 12 months or fewer for all alternatives, thus negating the need for calculating interest during construction (IDC). Only construction first costs are used to calculate annual costs. No OMRR&R have been included with this analysis. Cost estimates provided throughout the remainder of this appendix exclude the costs related to dredging activities that would occur independently of these ecosystem restoration features. Finally, no type of monitoring nor operation & maintenance is attached to this project; details to explain such to be found in the main report and/or the Appendix B-6 – Ecological Modeling.

	Project First Cost	Real Estate	IDC	Economic Cost	Annual Investment Cost	Annual M&AM	Annual OMRRR	Total Annual Cost
HICKORY COVE MARSH								
ALT 1A—500K CY of Marsh Creation	$1,813,000	$71,700	N/A	$1,884,700	$66,450	N/A	N/A	$66,450
ALT 1B—900K CY of Marsh Creation	$2,527,400	$93,100	N/A	$2,620,500	$92,400	N/A	N/A	$92,400
ALT 1C—1.3M CY of Marsh Creation	$2,567,000	$106,200	N/A	$2,673,200	$94,250	N/A	N/A	$94,250

ALT 2—1.3M CY of Marsh Creation + Breakwater	$25,617,100	$106,200	N/A	$25,723,300	$906,950	N/A	N/A	$906,950
ALT 3—1.3M CY of Marsh Creation + Breakwater + Living Shoreline	$28,523,000	$162,000	N/A	$28,685,000	$1,011,400	N/A	N/A	$1,011,400

3.4 Cost Effectiveness and Incremental Cost Analysis

To conduct the CE/ICA analysis, environmental restoration benefits (increase in with-project AAHUs) and annual costs were entered into IWR Planning Suite II. This resulted in 5 cost effective plans for each reach, shown in Table 3-3.

Cost effective plans are defined as the least expensive plan for a given set of benefits, or environmental output. In other words, no other plan would provide the same or more benefits for a lower cost. All combinability and dependency relationships were determined outside of the tools available within the IWR Planning Suite II software program by the environmental team members before providing the AAHUs for the CE-ICA analysis. As such, the “No plans can be combined” option was checked within IWR Planning Suite in running the analysis. Moreover, initially all five of the proposed plans qualified as Cost Effective Plans; subsequently three of the alternatives (plus by definition the No Action plan scenario) qualified as Best Buy Plans.

Table 3-1. Annual Benefits and Annual Cost for Cost Effective Alternatives

	Alternatives	AAHU	Annual Cost ($1s) October 2020 Prices
Hickory Cove Marsh	ALT 1A—500K CY of Marsh Creation	70.5	$66,450
	ALT 1B—900K CY of Marsh Creation	78.5	$92,400
	ALT 1C—1.3M CY of Marsh Creation	87.3	$94,250
	ALT 2—1.3M CY of Marsh Creation + Breakwater	256.4	$906,950
	ALT 3—1.3M CY of Marsh Creation + Breakwater + Living Shoreline	291.5	$1,011,400

3.4.1 Cost Effective Plans

Note that cost effective plans (red triangles) include those identified as “Best Buy” plans (green squares), which will be discussed in the next section.

Figure 3-1. Cost Effective Results

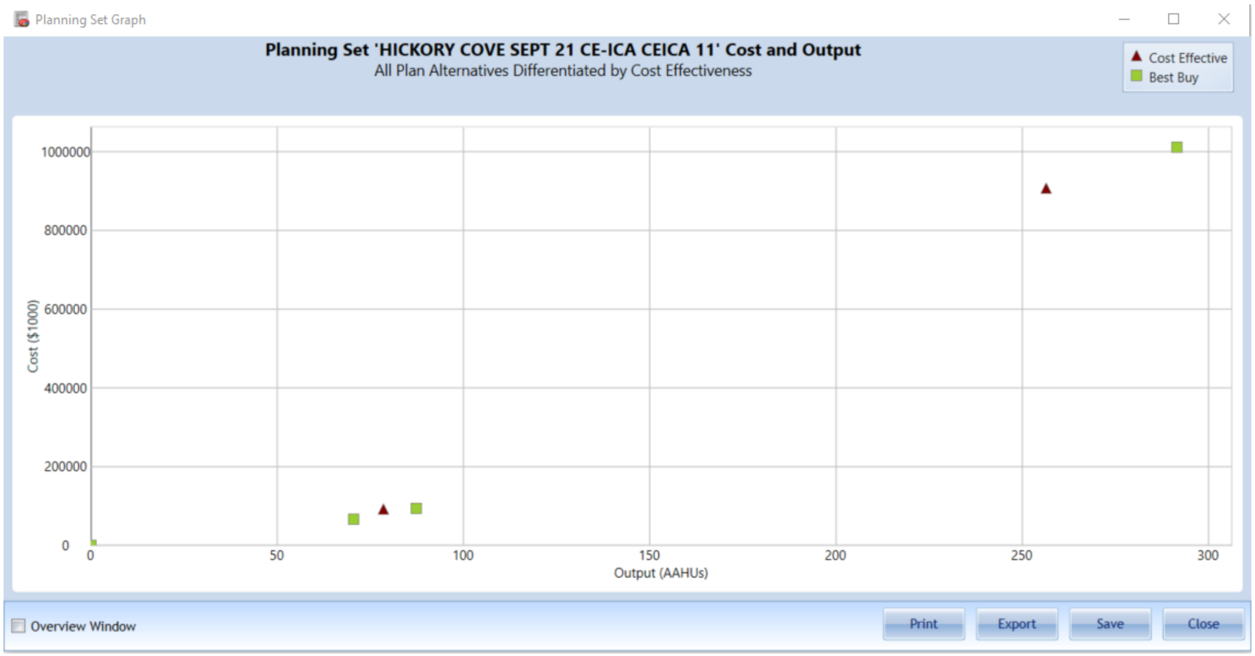


Table 3-2. Cost Effective Plans

Cost Effective Plans	Plan Description	AAHUs	Annualized Cost ($1s)	Annualized Cost/AAHUs ($1)
No Action Plan	No Action Plan	0	$0	0
ALT 1A—500K Marsh Creation		70.5	$66,450	$943
ALT 1B—900K Marsh Creation		78.5	$92,400	$1,177
ALT 1C—1.3M Marsh Creation		87.3	$94,250	$1,080
ALT 2—1.3M MC + Breakwater		256.4	$906,950	$3,537
ALT 3—1.3M MC + BW + Live Shoreline		291.5	$1,011,400	$3,470

3.4.2 Incremental Analysis and Best Buy Plans

The next step in the CE/ICA analysis is to perform an incremental cost analysis (ICA) on the cost-effective plans. ICA compares the incremental cost per incremental benefit (output or lift in environmental output) among the plans to identify plans that maximize the last dollar spent. Starting with the no action plan, the incremental cost per incremental benefit is calculated from the no action for each cost-effective plan. The plan with the least incremental cost per incremental output is identified as the first of the “with-project” best buy plans. Then starting with that plan, the incremental cost per incremental benefit is calculated between that plan and each remaining cost-effective plan, and the one with the least incremental cost per incremental benefit is identified as the next plan in the array of best buy plans. This process continues until there are there are no remaining plans. The last plan in the best buy array, is typically the “kitchen sink” plan, or the plan that contains all of the management measures being analyzed.

From the cost-effective alternatives, four were identified as “Best Buy” plans (including the No Action plan). The results of the analysis are shown graphically in

.

The alternative Best Buy plans are:

Plan 1: No Action
Plan 2: ALT 1A—500k-c.y. Marsh Creation
Plan 3: ALT 1C—1.3M-c.y. Marsh Creation
Plan 4: ALT 3—1.3M-c.y. Marsh Creation + Breakwater + Living Shoreline

Figure 3-2. Incremental Cost Analysis Result

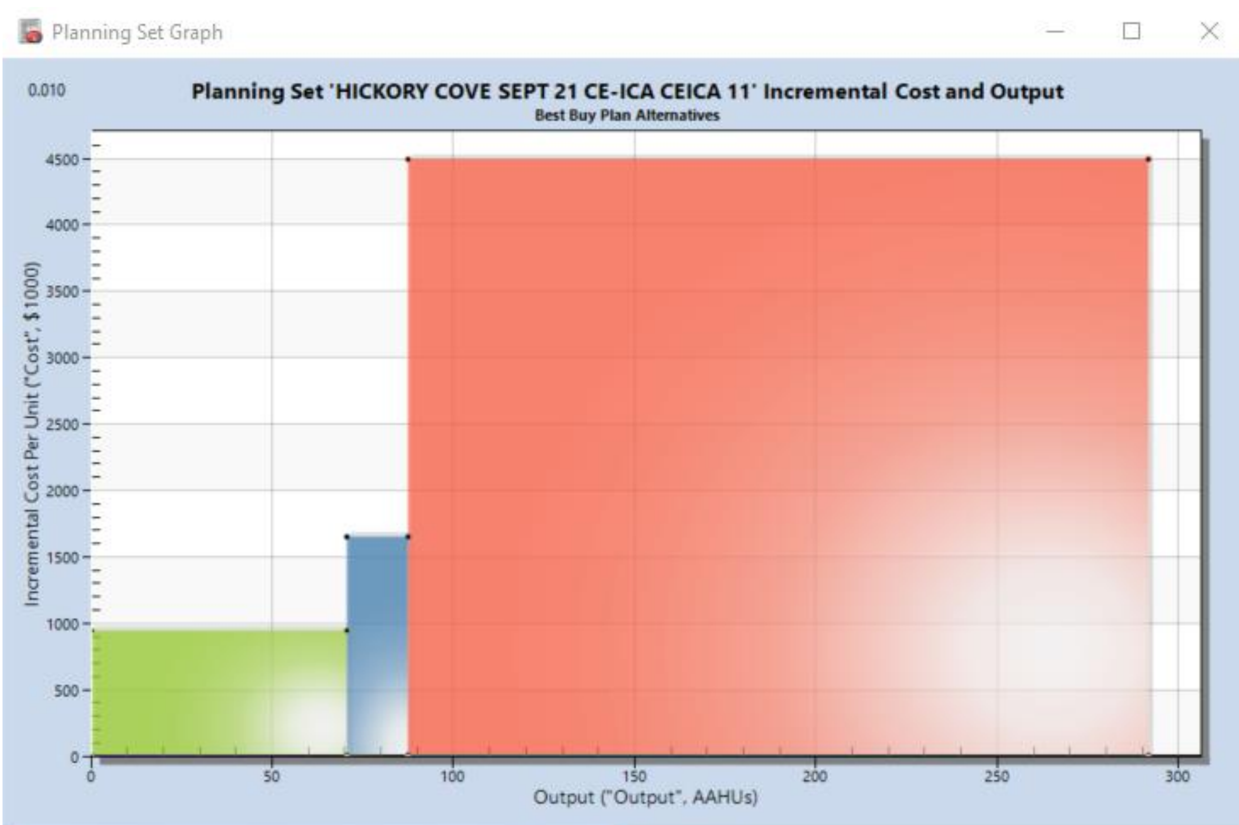


Table 3-3. Best Buy Plans

Plan	Outputs/ AAHUs	Total Annualized Cost ($1s)	Total Annualized Cost/AAHUs ($1s)	Incremental Ann. Cost ($1s)	Incremental AAHUs	Incremental Cost per AAHU	Plan First Costs
PLAN 1: NO ACTION	0	$0	0	0	0	0	$0
PLAN 2: ALT 1A—500k-c.y. Marsh Creation	70.5	$66,450	$943	$66,450	70.5	$943	$1,884,700
PLAN 3: ALT 1C—1.3M-c.y. Marsh Creation	87.3	$94,250	$1,080	$27,800	16.8	$1,655	$2,673,100
PLAN 4: ALT 3—1.3M-c.y. Marsh Creation + Breakwater + Living Shoreline	291.5	$1,011,400	$3,470	$917,150	204.2	$4,491	$28,685,000

3.4.3 "Is It Worth It?" Analysis of Best Buy Plans

No Action Plan: (0 AAHUs; $0 Ann Cost; $0 Incremental Cost; 0 Incremental AAHUs; $0 Increment Cost per AAHU; $0 Average Cost per AAHU).

The no action plan represents no federal action to address the degraded aquatic/riparian ecosystem, and the degradation would continue and increase over the 50-year period of analysis. Nor does this plan does not address the identified resources needed to achieve the planning objectives identified in the main report and the environmental analysis. While there is no cost associated with this plan, the PDT does not believe the action is worth the lack of investment, as it does not address any of the planning objectives and leaves the study area in its degraded state.

Alternative 1a—500k-c.y. Marsh Creation: (70.5 AAHUs; $66.4k Ann Cost; $66.4k Incremental Cost; 70.5 Incremental AAHUs; $943 Increment Cost per AAHU; $943 Average Cost per AAHU).

Yes. This alternative increases habitat over the No Action Plan by creating a rather unique wetlands area. Additionally, this alternative provides navigational benefits by serving as a placement area for future O&M dredging; the area currently lacks adequate placement areas for dredge material.

Alternative 1c—1.3M-c.y. Marsh Creation: (87.3 AAHUs; $94.3k Ann Cost; $27.8k Incremental Cost; 16.8 Incremental AAHUs; $1,655 Increment Cost per AAHU; $1,080 Average Cost per AAHU).

Yes. This alternative provides all of the benefits of the previously described plan. Moreover, the additional amount of dredge material (approximately 800k-c.y. will sustain the created marsh for a longer time period by reducing erosion and subsequent sediment loss.

Alternative 3—1.3M-c.y. Marsh Creation + Breakwater + Living Shoreline: (291.5 AAHUs; $1.0M Ann Cost; $917.2k Incremental Cost; 204.2 Incremental AAHUs; $4,491 Increment Cost per AAHU; $3,470 Average Cost per AAHU).

Yes. This plan would carry forward the benefits described for Alternative 1c, as well as provide other beneficial aspects. The breakwater measure is expected to provide for smaller nooks for nesting habitats for regional bird species. The breakwater is also expected to help reduce shoaling into the navigation waterway, which could then lessen future O&M dredging requirements, costs, and negative ecological impacts related to such. The combination of measures in this alternative also will allow for a wider variety of habitats to develop ecologically. Such marsh growth over a time period is expected to develop an outer ring that will aid in capturing sediment trying to escape the area. And finally, larger volumes of dredge material can be placed under this plan.

4 National Ecosystem Restoration and Recommended Plan

As outlined in ER-1105-2-100, an ecosystem restoration study must identify the National Ecosystem Restoration (NER) Plan. The NER plan is the justified alternative and scale having the maximum excess of monetary and non-monetary beneficial effects over monetary and non-monetary costs. It is the plan where the incremental beneficial effects just equal the incremental, or alternatively stated, where the extra environmental value is just worth the extra costs.

Upon comparing and evaluating the nine best-buy plans, performing an incremental cost analysis on those plans, and evaluating those incremental costs against the against the incremental benefits through the “Is It Worth It Analysis?”, Alternative 3 (1.3M c.y. Marsh Creation + Breakwater + Living Shoreline) has been identified as the NER Plan, and as such, is the recommend plan.

4.1 Cost Estimate of the Recommended Plan

Upon the determination of the recommended plan, an abbreviated risk assessment was made on the risk to cost and scope, which result in a more risk informed estimate of the project first costs. The estimated first cost for the recommended plan is $28,685,000, as shown in Figure 4-1. This includes $24,060,000 for features construction, $198,000 for land and damages, $2,646,600 for pre-engineering design, and $1,780,400 construction management.

Figure 4.1—Project First Costs (September 2021 Prices)

Feature	First Cost
Lands and Damages	$198,000
Marsh Creation	$2,150,000
Living Shoreline	$2,442,000
Breakwater	$19,468,000
PED	$2,646,600
Construction Mgmt	$1,780,400
Total	$28,685,000

Figure 4-2 shows the derivation of average annual costs, based on a 2.5% Federal interest rate and a 50-year period of analysis. The average annual cost of the recommended pan is $62,000, which provides a total lift of 156 average annual habitat units.

Figure 4-2. Derivation of Average Annual Costs (September 2021 Prices, 2.5% Federal Interest Rate, 50 Year Period of Analysis)

Cost Element	Cost
Project First Cost	$28,685,000
Interest During Construction	0
Investment Cost	$28,685,000
Amortization	1,011,400
Interest During Const.	0
Annual OMRRR	0
Average Annual Cost	**$1,011,400**
Average Annual Habitat Units	**291.5**

5 References

1994. "Executive Order No. 12898, 59 FR 7629."

USACE. 2011. "Corps of Engineers Civil Works Cost Definitions and Applicability." Memorandum, Director of Civil Works, Dated 27 Aug 2011.

U.S. Army Corps of Engineers. 2017. Economic Guidance Memorandum, 18-01, Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2018. Washington, D.C.: U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. 2000. "Planning Guidance Notebook, ER 1105-2-100."

U.S. Environmental Protection Agency. 2020. Internet URL: https://www.epa.gov/heat-islands/heat-island-impacts. Accessed on 01 April 2020.

Sect 1122 - Hickory Cove Marsh, Texas on the Sabine River

Section 1122 of the Water Resources Development Act (WRDA) 2016 directs the USACE to establish a pilot program to carry out 10 projects for the beneficial use of dredged material. NOTE: the costs for work breakdown Accounts 01,30, and 31 were developed and found in the TPCS only to prevent errors. The escaltion percentage is developed from the construction schedule and included in the TPCS. Contingences were develped in the Risk Analysis and were included in the TPCS, Due to the breakout of Federal and Non-Federal Sponsor costs rounding errors do occur, but they tally correctly.

Estimated by USACE SWG EC PS
Designed by USACE SWG EC
Prepared by Jackie Lockhart

Preparation Date 10/25/2021
Effective Date of Pricing 10/25/2021
Estimated Construction Time 840 Days

Description	Page
Project Cost Summary Report	**1**
005 Selected Plan	1
005-05 Federal	1
005-05-06 Fish and Wildlife Facilities	1
005-05-10 Breakwaters and Seawalls	1
005-05-12 Navigation Ports and Harbors	1

Description	Quantity	UOM	DirectCost	ProjectCost
Project Cost Summary Report			**25,033,125**	**26,799,866**
005 Selected Plan	**1.00**	**EA**	**25,033,125**	**26,799,866**
005-05 Federal	**1.00**	**EA**	**25,033,125**	**26,799,866**
005-05-06 Fish and Wildlife Facilities	**1.00**	**EA**	**3,298,214**	**3,586,734**
005-05-10 Breakwaters and Seawalls	**1.00**	**EA**	**13,382,815**	**14,861,035**
005-05-12 Navigation Ports and Harbors	**1.00**	**EA**	**8,352,097**	**8,352,097**

Abbreviated Risk Analysis

Hickory Cove Marsh
Alternative Formulation

Meeting Date: 17-Jun-20

PDT Members
Note: PDT involvement is commensurate with project size and involvement.

Represents	Name
Project Management:	Rueben Trevino
Planner:	Carrie McCabe
Environmental:	Jeff Pinsky
	Lorrie Taylor
Real Estate:	Nichole Schlund
OP Manager	Belynda Kinman
	Thomas West
Engineering & Design:	Molly Ross
Technical Lead:	Paul Hamilton
Cost Engineering:	Jackie Lockhart
Scheduler	Teri Conley
Program Analysis	Alvin Garcia

Meeting Date: Updated - 7/19/21

Project Management:	Gretchen Brown
Planner:	Carrie McCabe
Environmental:	Melinda Fisher
Real Estate:	Nichole Schlund
OP Manager	Belynda Kinman
Engineering & Design:	Molly Ross
Cost Engineering:	Jackie Lockhart

Abbreviated Risk Analysis

Project (less than $40M): **Hickory Cove Marsh**

Project Development Stage/Alternative: **Alternative Formulation**

Risk Category: **Low Risk: Typical Construction, Simple**

Alternative:

Meeting Date: **7/19/2021**

Total Estimated Construction Contract Cost = **$ 30,000**

	CWWBS	Feature of Work	Estimated Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0%	$ -	$ -
1	06 FISH AND WILDLIFE FACILITIES	Marsh Creation	$ 10,000		27%	$ 2,676	$ 12,676
2	12 NAVIGATION, PORTS AND HARBORS	Dredging	$ 10,000		31%	$ 3,054	$ 13,054
3	10 BREAKWATERS AND SEAWALLS	Breakwater	$ 10,000		35%	$ 3,549	$ 13,549
4					0%	$ -	$ -
5					0%	$ -	$ -
6					0%	$ -	$ -
8					0%	$ -	$ -
9					0%	$ -	$ -
10					0%	$ -	$ -
11					0%	$ -	$ -
12	All Other	**Remaining Construction Items**	$ -	0.0%	0%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**			0%	$ -	$ -
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**			0%	$ -	$ -
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals				
Real Estate	$ -	0%	$ -	$ -
Total Construction Estimate	$ 30,000	31%	$ 9,280	$ 39,280
Total Planning, Engineering & Design	$ -	0%	$ -	$ -
Total Construction Management	$ -	0%	$ -	$ -
Total Excluding Real Estate	**$ 30,000**	**31%**	**$ 9,280**	**$ 39,280**

	Base	50%	80%
Confidence Level Range Estimate ($000's)	$30k	$35k	$39k

* 50% based on base is at 5% CL.

Hickory Cove Marsh

Alternative Formulation

Abbreviated Risk Analysis

Meeting Date: 19-Jul-21

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
ect Management & Scope Growth					**Maximum Project Growth**		**40%**
Yes	PS-1	Marsh Creation	Potential for scope growth, added features?	There is some potential scope growth if additional marsh cells are created due to increase funding is available. A discrete event like Hurricane Harvey could cause more sediment material to become available.	Negligible	Possible	0
Yes	PS-2	Dredging	Potential for scope growth, added features? Funding difficulties?	A discrete event like Hurricane Harvey could cause more sediment material to become available. Sabine River has not been dredge for O&M since 2009 . Emergency dredging last occurred in 2012. There is no requirement to dredge to full depth. The District is trying to get material from Neches River, but is uncertain if Congress will fund the dredging.	Marginal	Possible	1
Yes	PS-3	Breakwater	Potential for scope growth, added features? Funding difficulties?	There is no expectation that the height or the length of the breakwater will change. Similar breakwater has been built in the area. Will need to verify Geotech during P&S. Funding uncertainty due to the pilot program and need to seek other sources.	Marginal	Possible	1
Acquisition Strategy					**Maximum Project Growth**		**30%**
Yes	AS-1	Marsh Creation	8A or Small Business	Cost concerns for reduced productivity of SBA or 8a Contractor. Small contractor likely.	Negligible	Possible	0
Yes	AS-2	Dredging	Contracting plan firmly established	Large 30" Pipeline Dredge was assumed for cost estimate due to pump length. Small business capability is unlikely, use of large contractor is expected.	Negligible	Likely	1
Yes	AS-3	Breakwater	Contracting plan firmly established/8a or Small Business	PDT assumed this would be one contract. If Duck Unlimited, (the study partner), does not a line with our funding needs it might require multiple contracts.	Marginal	Possible	1
Construction Elements					**Maximum Project Growth**		**15%**
Yes	CON-1	Marsh Creation	• Special equipment or subcontractors needed?	Access maybe restricted to water, which could increase mob & demob cost.	Marginal	Possible	1
Yes	CE-2	Dredging	• Potential for construction modification and claims?	There is always a potential for construction modifications and claim. This work uses standard construction methods used in the Galveston District.	Marginal	Possible	1
Yes	CE-3	Breakwater	• High risk or complex construction elements, site access, in-water? • Potential for construction modification and claims?	Access is by water There is always a potential for construction modifications and claim. This work uses standard construction methods used in the Galveston District.	Marginal	Possible	1
ialty Construction or Fabrication					**Maximum Project Growth**		**50%**
Yes	SC-1	Marsh Creation	High risk or complex construction elements, site access, in-water?	Environmental success standpoint is tied to getting target elevation, which required moving the dredge pipe a lot so you don't have high or low spots. That can be difficult to achieve if you're working in really soft material	Marginal	Possible	1
Yes	SC-2	Dredging	Confidence in constructability and methodology?	This portion of work does not have any specialty equipment. It is very standard construction.	Negligible	Unlikely	0
Yes	SC-3	Breakwater	Confidence in constructability and methodology?	This portion of work does not have any specialty equipment. It is very standard construction.	Negligible	Unlikely	0

Technical Design & Quantities					**Maximum Project Growth**		**20%**
Yes	T-1	Marsh Creation	Possibility for increased quantities due to loss, waste, or subsidence? Sufficient investigations to develop quantities?	Possible subsidence of marsh with more material required to meet desired marsh elevation. Starting marsh elevation is possible to have some error involved. Additional data sources may be available for later milestones to validate initial assumption. More Geotech analysis will not occur until design and implementation. Unknow if timing of funding may change dredging requirements.	Marginal	Possible	1
Yes	T-2	Dredging	Sufficient investigations to develop quantities.	Feasibility level investigations have been performed, and additional investigations will be conducted during PED.	Marginal	Possible	1
Yes	T-3	Breakwater	• Possibility for increased quantities due to loss, waste, or subsidence?	Additional investigations will occur in PED to verify breakwater design plans against geotechnical conditions. If subsidence is expected to occur, quantities may increase.	Moderate	Unlikely	1
Cost Estimate Assumptions					**Maximum Project Growth**		**25%**
Yes	EST-1	Marsh Creation	• Site accessibility, transport delays, congestion?	Current assumption is that access will be by boat.	Negligible	Possible	0
Yes	EST-2	Dredging	Assumptions regarding crew, productivity, overtime?	Cost estimate was consistent with level of design performed. Use of historical data & parametric estimating is acceptable for early study milestones, but costs could increase with later refinement. However, use of CEDEP for dredging helps to reduce impact of under estimating costs.	Marginal	Possible	1
Yes	EST-3	Breakwater	• Assumptions regarding crew, productivity, overtime?	Cost estimate was consistent with level of design performed. Use of historical data & parametric estimating is acceptable for early study milestones. Likelihood of cost increase is not likely, and any increases would have moderate impact.	Moderate	Unlikely	1
External Project Risks					**Maximum Project Growth**		**20%**
Yes	EX-1	Marsh Creation	• Funding Constraints	This is a pilot study, therefor there is more certainty that the district will get the funding. Because of this funding has been preliminarily approved. Nothing has been set aside.	Significant	Possible	3
Yes	EX-2	Dredging	• Funding Constraints	Uncertainty on when and if funding for dredging will be appropriated.	Significant	Possible	3
Yes	EX-3	Breakwater	Funding Constraints	This is a pilot study, therefor there is more certainty that the district will get the funding. Even though the funding has been preliminarily approved, nothing has been set aside. If insufficient funding is provided then it would be dependent on outside sources to implement.	Significant	Likely	4

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: **Hickory Cove Marsh Section 1122 Beneficial Use Pilot Study Bidge City, Texas**
DISTRICT: **Galveston District**
PREPARED: **10/25/2021**
PROJECT NO: **479586**
LOCATION: **Sabine River, Texas**
POC: **CHIEF, COST ENGINEERING,Martin Regner, P.E. , C.C**

This Estimate reflects the scope and schedule in report; Report Name and date

Civil Works Work Breakdown Structure		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**						**TOTAL PROJECT COST (FULLY FUNDED)**			
						Program Year (Budget EC): 2022									
						Effective Price Level Date: 1-Oct- 21									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: **1-Oct-21** ($K)	**TOTAL FIRST COST ($K)**	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
06	FISH & WILDLIFE FACILITIES	$3,587	$1,112	31%	$4,699		$3,587	$1,112	$4,699		$4,699	8.5%	$3,893	$1,207	$5,100
												-			
10	BREAKWATER & SEAWALLS	$14,861	$4,607	31%	$19,468		$14,861	$4,607	$19,468		$19,468	10.5%	$16,424	$5,091	$21,515
12	NAVIGATION PORTS & HARBORS	$8,325	$2,581	31%	$10,906		$8,325	$2,581	$10,906		$10,906	12.9%	$9,397	$2,913	$12,310
	CONSTRUCTION ESTIMATE TOTALS:	$26,773	$8,300		$35,073		$26,773	$8,300	$35,073		$35,073	11.0%	$29,714	$9,211	$38,925
01	LANDS AND DAMAGES	$129	$32	25%	$161		$129	$32	$161		$161	5.2%	$136	$34	$170
30	PLANNING, ENGINEERING & DESIGN	$2,965	$917	31%	$3,882		$2,965	$917	$3,882		$3,882	5.6%	$3,130	$968	$4,098
31	CONSTRUCTION MANAGEMENT	$1,981	$614	31%	$2,595	0.0%	$1,981	$614	$2,595		$2,595	7.7%	$2,133	$661	$2,795
	PROJECT COST TOTALS:	$31,848	$9,863	31%	$41,711		$31,848	$9,863	$41,711		**$41,711**	10.3%	$35,112	$10,875	$45,987

ESTIMATED TOTAL PROJECT COST: $45,987

______________________ CHIEF, COST ENGINEERING,Martin Regner, P.E. , C.C.E.

______________________ PROJECT MANAGER, Grechen Brown

______________________ CHIEF, REAL ESTATE, Timothy Nelson

______________________ CHIEF, PLANNING, Andrea Catanzaro

______________________ CHIEF, ENGINEERING, Willie Joe Honza, P.E.

______________________ CHIEF, OPERATIONS, Chris C. Frabota

______________________ CHIEF, CONSTRUCTION, Don Carelock, P.E.

______________________ CHIEF, CONTRACTING, Shamekia Chapman

______________________ CHIEF, PM-PB, Nicholas Laskowski , P.G., PWS

______________________ CHIEF, DPM, Byron D. Williams, P.E.

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Hickory Cove Marsh Section 1122 Beneficial Use Pilot Study Bidge City, Texas
LOCATION: Sabine River, Texas
This Estimate reflects the scope and schedule in report; Report Name and date

DISTRICT: Galveston District
POC: CHIEF, COST ENGINEERING,Martin Regner, P.E. , C.C.E.
PREPARED: 10/25/2021

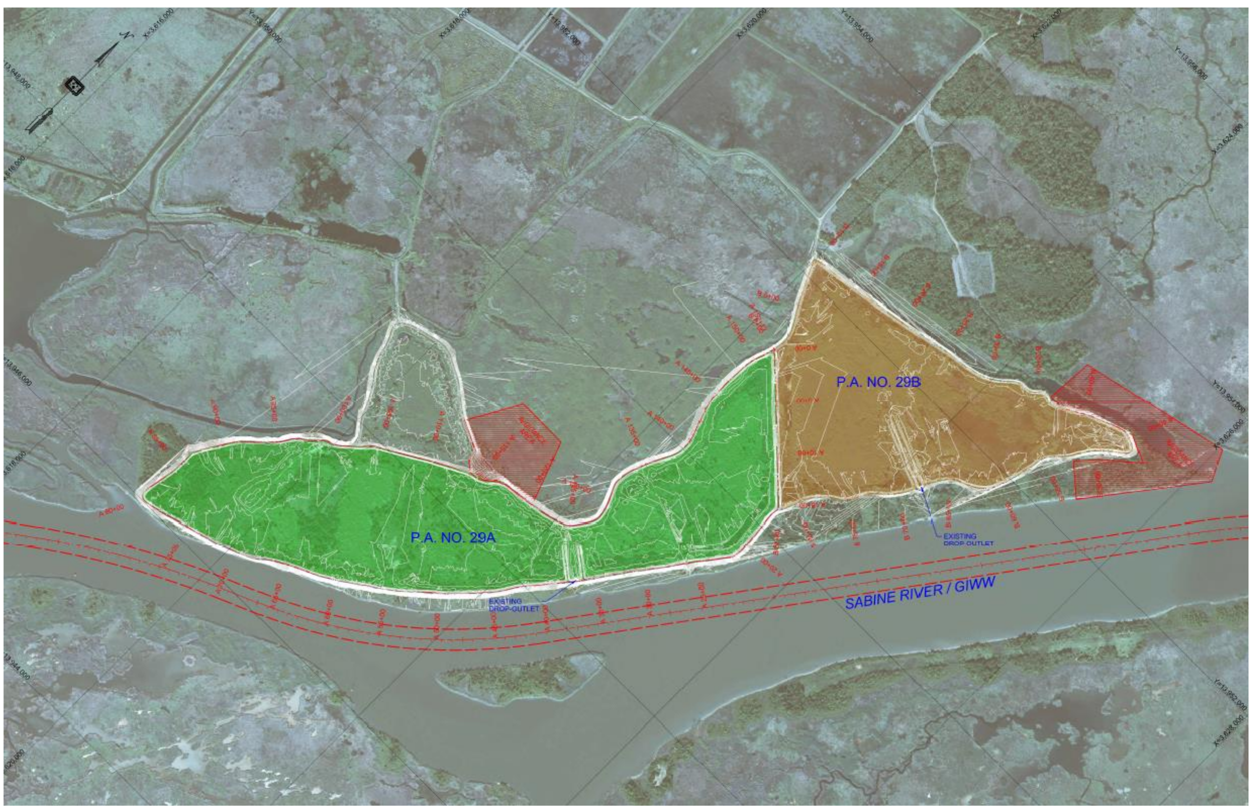
WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			9-Sep-21	Program Year (Budget EC):			2022					
		Estimate Price Level:			1-Oct-21	Effective Price Level Date:			1 -Oct-21					
				RISK BASED										
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	Living Shoreline													
06	FISH & WILDLIFE FACILITIES	$1,864	$578	31.0%	$2,442		$1,864	$578	$2,442	2025Q3	9.2%	$2,035	$631	$2,666
	Marsh Creation													
06	FISH & WILDLIFE FACILITIES	$1,723	$534	31.0%	$2,257		$1,723	$534	$2,257	2025Q1	7.8%	$1,858	$576	$2,434
10	BREAKWATER & SEAWALLS	$14,861	$4,607	31.0%	$19,468		$14,861	$4,607	$19,468	2026Q1	10.5%	$16,424	$5,091	$21,515
12	NAVIGATION PORTS & HARBORS	$8,325	$2,581	31.0%	$10,906		$8,325	$2,581	$10,906	2025Q1	12.9%	$9,397	$2,913	$12,310
	CONSTRUCTION ESTIMATE TOTALS:	$26,773	$8,300	31.0%	$35,073		$26,773	$8,300	$35,073			$29,714	$9,211	$38,925
01	LANDS AND DAMAGES	$129	$32	25.0%	$161		$129	$32	$161	2024Q1	5.2%	$136	$34	$170
30	PLANNING, ENGINEERING & DESIGN													
0.8%	Project Management	$214	$66	31.0%	$280		$214	$66	$280	2024Q1	5.1%	$225	$70	$295
1.2%	Planning & Environmental Compliance	$321	$100	31.0%	$421		$321	$100	$421	2024Q1	5.1%	$337	$105	$442
4.0%	Engineering & Design	$1,063	$330	31.0%	$1,393		$1,063	$330	$1,393	2024Q1	5.1%	$1,117	$346	$1,463
0.8%	Reviews, ATRs, IEPRs, VE	$214	$66	31.0%	$280		$214	$66	$280	2024Q1	5.1%	$225	$70	$295
0.5%	Life Cycle Updates (cost, schedule, risks)	$134	$42	31.0%	$176		$134	$42	$176	2024Q1	5.1%	$141	$44	$184
0.4%	Contracting & Reprographics	$107	$33	31.0%	$140		$107	$33	$140	2025Q1	7.7%	$115	$36	$151
1.2%	Engineering During Construction	$321	$100	31.0%	$421		$321	$100	$421	2025Q1	7.7%	$346	$107	$453
0.3%	Planning During Construction	$80	$25	31.0%	$105		$80	$25	$105	2024Q1	5.1%	$84	$26	$110
1.2%	Adaptive Management & Monitoring	$321	$100	31.0%	$421		$321	$100	$421	2024Q2	5.7%	$339	$105	$445
0.6%	Project Operations	$161	$50	31.0%	$211		$161	$50	$211	2024Q2	5.7%	$170	$53	$223
	Real Estate In-House Labor	$29	$7	25.0%	$36		$29	$7	$36	2024Q2	5.7%	$31	$8	$38
						$3,635								
31	CONSTRUCTION MANAGEMENT													
5.0%	Construction Management	$1,339	$415	31.0%	$1,754		$1,339	$415	$1,754	2025Q1	7.7%	$1,442	$447	$1,889
1.2%	Project Operation:	$321	$100	31.0%	$421		$321	$100	$421	2025Q1	7.7%	$346	$107	$453
1.2%	Project Management	$321	$100	31.0%	$421		$321	$100	$421	2025Q1	7.7%	$346	$107	$453
	CONTRACT COST TOTALS:	$31,848	$9,863		$41,711		$31,848	$9,863	**$41,711**			$35,112	$10,875	**$45,987**
						$2,806								

Filename: CAP TPCS V3.0 - Hickory cove Marsh.xlsx
TPCS

Appendix F: Base Plan Site Improvement Summary

Location

This upland site is located on a small bluff along the left ascending bank at the mouth of the middle pass of the Sabine River delta in Orange Co. Texas. The site contains two placement cells; Cell B in the northerly portion containing 175 acre's and Cell A in the southerly portion containing 500 acre. There is an existing engineered outfall structure in each cell. Two exclusive areas are directly adjacent to the existing embankments and should be avoided. The exact nature of the avoidance areas is unknown. These avoidance areas occur in low laying areas along the northerly margin between the banks of Coon Bayou and the Sabine river of containment Cell A and an additional area along the northern perimeter in the Southerly portion of containment Cell A. The Sabine River navigation channel occurs along the southern border and the centerline of it serves to delineate the political boundary between the states of Texas and Louisiana.



Current Conditions

- Outlet structures at both 29A and 29B need to be replaced to make site operational

	29A	29B	Total	
[1]Current Capacity (cu yds)	233,194	111,113	344,307	

Note 1: Current capacities doesn't maintain a 3 ft Freeboard throughout the PA.

Pictures from Site visit conducted in 2012.
W:\CADD\projects\Placement-Areas\SNWW\SABINE RIVER PLACEMENT AREA 29\photos

Dike Raise Options

	29A	29B	Total	
[1]Raise to Both Cells to Elev. +13.0 ft (cu yds)	233,194*	522,635	755,828	
[1]Raise Both Cells to Elev. +16.0 ft (cu yds)	816,580	975,065	1.8 million	

Note 1: This elevation includes the required 3 ft Freeboard.
*Note *: This option will only increase Freeboard to 29A. It will not increase the current capacities.*

Quantities

Listed below are basic quantities needed to make both sites operational. Some smaller items needed for construction are not shown below.

A. Current Conditions

Item No.	Description	Estimated Quantity	Unit
XXXX	New Drop-Outlet Structure (4 Bays)	1	Job
XXXX	New Drop-Outlet Structure (3 Bays)	1	Job

B. Raise to Elev. +13.0 ft

Item No.	Description	Estimated Quantity	Unit
XXXX	New Drop-Outlet Structure (4 Bays)	1	Job
XXXX	New Drop-Outlet Structure (3 Bays)	1	Job
XXXX	Semi-compacted Containment Dike Raise	194,159	C.Y.
XXXX	Perimeter Ditch	23,392	L.F.

C. Raise to Elev. +16.0 ft

Item No.	Description	Estimated Quantity	Unit
XXXX	New Drop-Outlet Structure (5 Bays)	1	Job
XXXX	New Drop-Outlet Structure (3 Bays)	1	Job
XXXX	Semi-compacted Containment Dike Raise	281,062	C.Y.
XXXX	Perimeter Ditch	23,392	L.F.