FINAL DAMAGE ASSESSMENT AND RESTORATION PLAN/ ENVIRONMENTAL ASSESSMENT FOR THE MAY 2019 BAYPORT CHANNEL COLLISION IN GALVESTON BAY, TEXAS

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PREPARED BY:

Texas Commission on Environmental Quality

Texas General Land Office

Texas Parks and Wildlife Department

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EXECUTIVE SUMMARY

On May 10, 2019, the tanker ship VLGC *Genesis River* (*Genesis River*) collided with the tugboat *Voyager* in the Houston Ship Channel near Bayport, Texas (Collision). The Collision caused approximately 600,000 gallons of reformate (a colorless, refined petroleum product) to rapidly discharge into the Houston Ship Channel and Galveston Bay (Spill). Spilled reformate was observed in upper Galveston Bay along with dead stranded aquatic organisms (fish and invertebrates) along the western shoreline of Galveston Bay between Red Bluff and Clifton Beach. For purposes of natural resource damages, Kirby Inland Marine, L.P. (Kirby) was identified as the Responsible Party for the Spill.

The Texas Commission on Environmental Quality; the Texas General Land Office; the Texas Parks and Wildlife Department; and the United States Department of Commerce, represented by the National Oceanic and Atmospheric Administration, (collectively referred to as "the Trustees") conducted a Natural Resource Damage Assessment (NRDA) in cooperation with the Responsible Party, Kirby. The assessment found that the Spill resulted in acute injury to aquatic organisms throughout the water column.

On September 1, 2021, the United States District Court for the Southern District of Texas entered a Consent Decree resolving the Trustees' claims for injuries to natural resources resulting from the Spill. Kirby agreed to pay $1,695,802 in damages and assessment costs to resolve federal and state claims for injuries to natural resources and services resulting from the Spill. The Trustees intend to use the settlement funds to restore for water column injuries. The settlement also provides sufficient funding for the Trustees' costs to oversee, implement, and monitor the restoration of natural resources.

The Draft Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA) was made available for public review and comment for 30 days. Notice of the public review period was published in the Texas Register (vol 50, no. 29, pages 4124-4125). No comments were received during the review period and the Trustees finalized the DARP/EA without any substantive changes.

This Final DARP/EA was prepared jointly by the Trustees. This DARP/EA is issued to inform the public of the Trustees' authorities and responsibilities under the Oil Pollution Act of 1990 (33 United States Code [U.S.C.] 2701 et seq.), the Texas Oil Spill Prevention and Response Act of 1991 (Texas Natural Resource Code (TNRC) §§ 40.00 et seq.), and the National Environmental Policy Act (83 Stat. 852; 42 U.S.C. 4321 et seq.). In this DARP/EA, the Trustees evaluate potential restoration projects that exhibit a sufficient relationship to the natural resources injured and would compensate the public for natural resource losses resulting from the Spill. The Trustees used a Habitat Equivalency Analysis to estimate the restoration necessary to restore the injury. Using this information, the Trustees selected the Gordy Marsh Living Shoreline project as the preferred restoration project. This restoration project includes construction of a breakwater to protect wetland and coastal prairie habitat and the creation of marsh habitat by planting marsh grasses behind the constructed breakwater.

ABBREVIATIONS

CEPRA	Coastal Erosion Planning and Response Act
DARP/EA	Damage Assessment and Restoration Plan/Environmental Assessment
DSAY	Discounted Service Acre Year
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
GBF	Galveston Bay Foundation
GLO	Texas General Land Office
GOMESA	Gulf of Mexico Energy Security Act
HEA	Habitat Equivalency Analysis
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damages Assessment
OPA	Oil Pollution Act of 1990
OSPRA	Texas Oil Spill Prevention and Response Act of 1991
SAV	Submerged Aquatic Vegetation
SCAT	Shoreline Cleanup Assessment Technique
TCEQ	Texas Commission on Environmental Quality
TNRC	Texas Natural Resource Code
TPWD	Texas Parks and Wildlife Department
USFWS	United States Fish and Wildlife Service
USCG	United States Coast Guard

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1 INTRODUCTION

1.1 Purpose and Need for Restoration

On May 10, 2019, the tanker ship VLGC *Genesis River* (*Genesis River*) collided with the tugboat *Voyager* in the Houston Ship Channel near Bayport, Texas (Collision). At the time of the Collision, the *Voyager* was pushing two tank barges owned and operated by Kirby Inland Marine, L.P. (Kirby). The Collision resulted in a cut through the hull of a barge owned and operated by Kirby, rupturing the barge's oil storage tanks and rapidly discharging an estimated 14,278 barrels (about 600,000 gallons) of reformate, a gasoline blending stock, into the Houston Ship Channel and Galveston Bay (Spill). Kirby was identified as the Responsible Party for natural resource damages resulting from the Spill.

Natural resources within Galveston Bay and the Houston Ship Channel were injured from exposure to reformate as a result of the Spill. Spilled reformate and dead fish and invertebrates washed ashore on the western shore of Galveston Bay. Dead organisms included surface dwelling, mid-water, and benthic organisms, which suggests that the reformate mixed into and impacted the entire water column, from surface to sediment. This led the Trustees to quantify damages to natural resources related to water column injuries.

This Final Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA) is part of the Natural Resource Damage Assessment (NRDA) process being performed pursuant to the Oil Pollution Act of 1990 (OPA) and the Texas Oil Spill Prevention and Response Act of 1991 (OSPRA) by the Texas General Land Office (GLO), the Texas Commission on Environmental Quality (TCEQ), the Texas Parks and Wildlife Department (TPWD), and the National Oceanic and Atmospheric Administration (NOAA), collectively referred to as the Trustees. This DARP/EA also serves as a National Environmental Policy Act (NEPA) Environmental Assessment. It evaluates the reasonably foreseeable impacts of the proposed restoration projects[1] on the quality of the physical, biological, and socioeconomic resources in the Galveston Bay area.

This DARP/EA presents information about the affected environment (Chapter 2), the Trustees' injury assessment and quantification process (Chapter 3), the evaluated restoration projects (Chapter 4), and the environmental impacts of undertaking the proposed restoration project (Chapter 5).

1.2 Summary of the Collision

On May 10, 2019, the *Genesis River* collided with the tugboat *Voyager* in the Houston Ship Channel near Bayport, Texas (Figure 1.1). At the time of the Collision, the *Voyager* was pushing two tank barges owned and operated by Kirby. The Collision resulted in a cut through the hull of Kirby's barge *30015T*, rupturing the oil storage tanks and rapidly discharging an estimated

[1] OPA and NEPA regulations use the term "alternative." In this document, the terms "project" and "alternative" are synonymous.

14,278 barrels (about 600,000 gallons) of reformate into the Houston Ship Channel and Galveston Bay. The damaged barge continued to release reformate through May 11, 2019, and surface sheening persisted in open water to the south through May 12, 2019. The second Kirby barge, *MMI3041*, capsized but did not release any product.

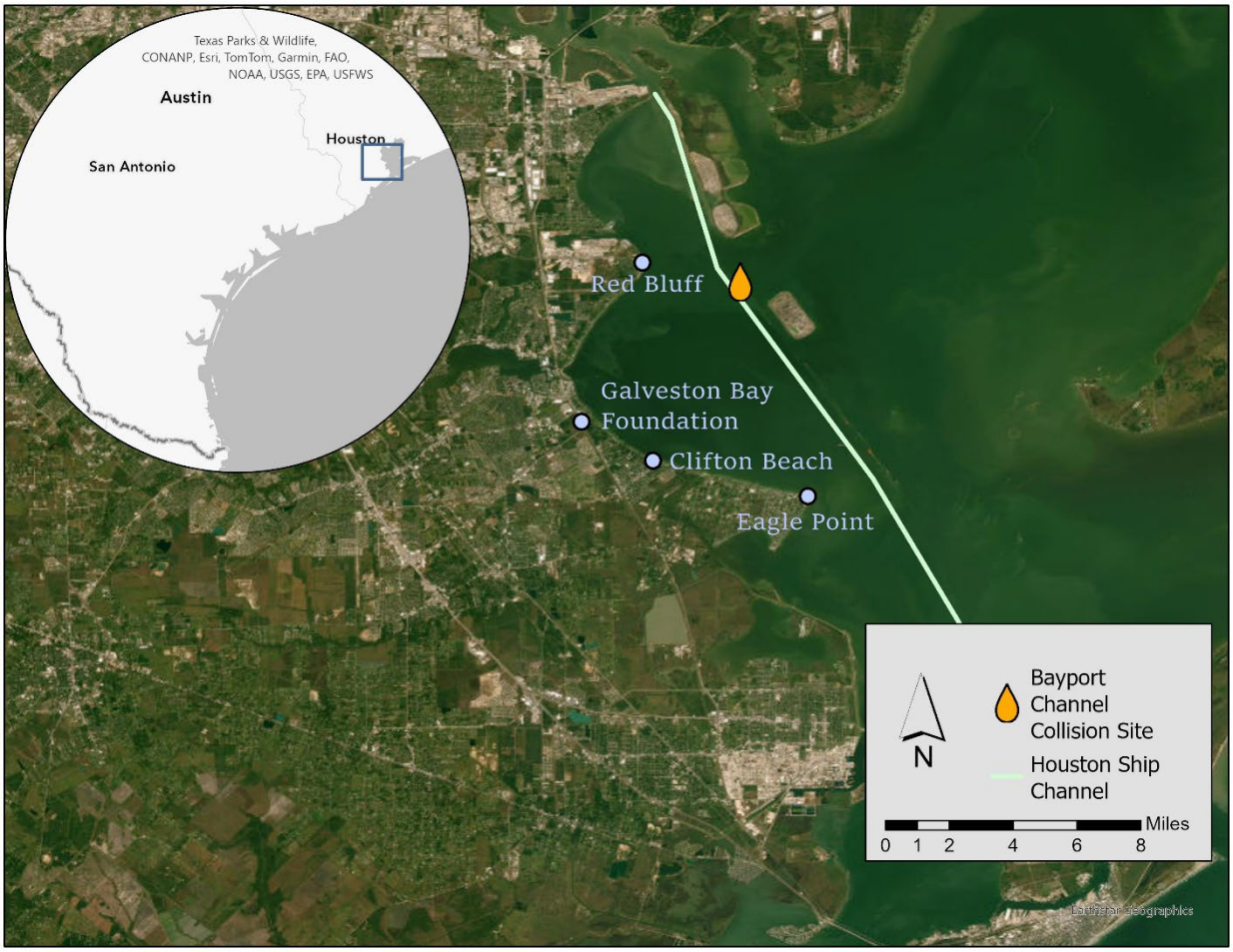

Figure 1.1 Location of the Bayport Channel Collision in Galveston Bay, Texas. Inset shows the location (black rectangle) relative to the Texas coast.

At the time of the Collision, weathering of the reformate through evaporation and dispersion into the water column was expected due to the chemical properties of the spilled product and the weather. However, the spilled reformate did not act as the initial trajectory developed by Incident Command predicted. Surface sheens persisted longer and were transported farther than expected, resulting in unanticipated oiling of shorelines and water column toxicity. In addition, the pure reformate that was spilled was clear (LSU 2019), making it difficult to track by traditional visual observations once released into the environment.

1.3 Summary of Response Actions

Federal and State Trustee agencies, as well as Kirby and its oil spill response operators responded to the Spill as part of an Incident Command. The United States Coast Guard (USCG)

assumed leadership of the Incident Command in its role as Federal On-Scene Coordinator. The Incident Command included representatives from the USCG, Kirby, and GLO, with support from the Port of Houston, United States Environmental Protection Agency, NOAA, TPWD, TCEQ, Galveston County Health District, Texas Department of Health and Human Services, and the Center for Disease Control and Prevention. The USCG and Captain of the Port of Houston closed the Houston Ship Channel from Light 61 to 75 as well as the Clear Creek Channel on May 10, 2019, prohibiting boaters from entering Galveston Bay from the Clear Creek Channel. According to the National Transportation Safety Board (2021), "The Houston Ship Channel was closed during response operations for two days and did not fully open for navigation until May 15."

The USCG initiated aerial reconnaissance within 12 hours of the Spill to determine the extent of oil and observed a surface sheen extending south for approximately 1 to 2 miles from the Collision location (Figure 1.1 and Figure 1.2). Response actions included deployment of absorbent and containment booms around the damaged and capsized barges and environmentally sensitive shoreline areas as well as deployment of oil skimmer boats to recover accessible oil on the surface.

Figure 1.2 Photograph of the surface sheen taken on a USCG aerial overflight on May 10, 2019.

To facilitate reporting, hotlines for the public to report strong gasoline odors, waterway contamination, and wildlife impacts were activated on May 11, 2019. Air monitoring was conducted early during the Spill after reports of strong chemical odors from communities in western Galveston Bay. The Texas Department of State Health Services closed portions of oyster reefs in Galveston Bay and advised against eating fish caught in Galveston and Trinity bays. The

State-issued seafood advisory remained in effect through May 15, 2019 (Kinney 2019). Remaining product was removed from the damaged barge, the capsized barge was refloated, and both barges were removed from the area within a week of the Spill.

Shoreline Cleanup Assessment Technique (SCAT) teams were deployed to locate shoreline oiling. Shoreline oiling was difficult to observe due to access limitations, hardened shoreline (i.e., rip-rap and seawall), and the lack of color in the spilled product. However, assessments from USCG aerial reconnaissance, SCAT teams, and NRDA Trustees indicated that shoreline oiling likely extended from Red Bluff to Eagle Point (Figure 1.1). Product accumulated on the shoreline and saturated the beach at properties in Kemah, Texas, including a portion of natural shoreline owned by the Galveston Bay Foundation (GBF). The GBF property and adjacent private property were cleared of oiled debris and wrack and cleaned using tilling and surf washing with boom in place to contain and recover product. Shoreline cleaning concluded on June 7, 2019. During the spill response, a large accumulation of dead organisms, including fish and invertebrates from benthic and pelagic bay habitats, were collected at the properties where oil accumulated. While wildlife teams searched upper western Galveston Bay shorelines for additional injured or dead animals, the combination of a hardened shoreline, rip-rap, and private property made locating and recovering animals difficult.

1.4 NRDA Authority

This DARP/EA has been jointly prepared by the Trustees pursuant to their respective authorities and responsibilities as natural resource trustees. NOAA was designated as the federal Trustee for this Spill pursuant to Section 1006(b)(2) of OPA, 33 U.S.C. § 2706(b)(2), Subpart G of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 C.F.R. §§ 300.600, *et seq*.) and Executive Order (EO)12580 (3 C.F.R., 1987 Comp. p. 193, 52 Fed. Reg. 2923 (January 23, 1987) as amended by EO 12777 (56 Fed. Reg. 54757 (October 19, 1991)). State Trustees for Texas are designated by the Governor of Texas pursuant to the NCP (40 C.F.R. §300.605) and include TCEQ, GLO, and TPWD. Each designated Trustee is authorized to act on behalf of the public to assess and recover natural resources and resource services injured or lost as the result of an oil spill.

1.5 Overview of Legal Requirements

The NRDA process conducted pursuant to OPA and OSPRA, and the regulations promulgated thereunder in 15 C.F.R. Part 990 and 31 TAC §19.54 respectively, consists of three phases: (1) Preassessment, (2) Injury Assessment and Restoration Planning, and (3) Restoration Implementation. OPA authorizes federal, state, and tribal natural resource trustees to initiate a damage assessment when natural resources may have been injured and/or natural resource services impaired as a result of a discharge of oil or a substantial threat of such a discharge. OPA regulations provide specific definitions for the following terms:

- "Injury" is "an observable or measurable adverse change in a natural resource or impairment of a natural resource service;"
- "Natural resources" are "land, fish, wildlife, biota, air, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by,

appertaining to, or otherwise controlled by the United States, any state or local government, or Indian tribe," and

- "Natural resource services" are "functions performed by a natural resource for the benefit of another resource and/or the public."

During the response, the Trustees initiated the Preassessment Phase to determine whether there was jurisdiction to pursue a NRDA and, if so, whether it would be appropriate for the Trustees to pursue the case. During the Preassessment Phase, the Trustees determined that they had jurisdiction to conduct a NRDA under OPA, determining that: (1) one or more incidents had occurred; (2) the discharge included, "but [was] not limited to, spilling, leaking, pumping, pouring, emitting, emptying, or dumping," as defined in section 1001(7) of OPA (33 U.S.C. 2701(7)) and was not from a public vessel, from an onshore facility subject to the Trans-Alaska Pipeline Authorization Act, and was not permitted under federal, state, or local law; and (3) public trust natural resources and/or services under the jurisdiction of the Trustees may have been injured as a result of the discharge. Under 15 C.F.R. § 990.42, the Trustees also determined that response actions did not adequately address the injuries and that feasible primary and/or compensatory restoration projects existed to address the injuries. On the basis of those determinations, on July 14, 2021, the Trustees issued the Notice of Intent to Conduct Restoration Planning (Notice of Intent) for the Spill.

The Trustees then initiated the Injury Assessment and Restoration Planning Phase, evaluating and quantifying the nature and extent of injuries to natural resources and services. The first component of this phase was injury assessment under 15 C.F.R. §§ 990.51-990.52. As provided in 15 C.F.R. §990.14(c)(1), the Trustees invited Kirby to participate in the injury assessment component of the NRDA (see also Section 1.7). The second component of this phase was restoration selection under 15 C.F.R. §§ 990.53-990.56 (also known herein as the Trustees' Restoration Planning Phase) where the Trustees considered the nature and extent of exposure and/or injuries to natural resources caused by the Spill. The Trustees developed a plan for restoring the injured resources and services, which is set forth in this DARP/EA. The Trustees identified a reasonable range of restoration projects and evaluated those projects to determine the preferred restoration project. As a part of this process, the Trustees considered the evaluation standards contained in 15 C.F.R. 990.54.

1.6 National Environmental Policy Act Compliance

Under OPA, federal actions that may significantly impact the human environment, including the restoration of natural resources, must comply with NEPA, as amended (42 U.S.C. 4321 et seq.). In compliance with NEPA, this DARP/EA identifies potential restoration projects, describes the purpose and need for the action, evaluates reasonably foreseeable environmental consequences, and provided an opportunity for public participation in the decision-making process. The information on environmental consequences will be used in making a threshold determination as to whether preparation of an Environmental Impact Statement (EIS) is required prior to the selection of the Trustees' preferred restoration project. An EIS will be prepared if the threshold determination indicates the proposed project may have significant impact on the environment. If an EIS is not warranted, the federal agencies will issue a Finding of No Significant Impact, and a

Final DARP/EA will be published after consideration of public comment. NOAA is the lead federal agency for the purposes of this NEPA analysis.

1.7 Coordination with Responsible Party

The OPA regulations for NRDA (15 C.F.R. §990.14 (c)(1)) and the OSPRA statute (TNRC §40.107(c)(5)) require the Trustees to invite the responsible party to participate in the damage assessment process. Accordingly, the Trustees invited Kirby to participate in the damage assessment process for this Spill. Kirby formally accepted the Trustee's invitation on May 23, 2019. Prior to this time, the Trustees and Kirby worked cooperatively to collect ephemeral field data for Preassessment and injury assessment analyses.

Information collected by all parties was shared, as were the results of analyses undertaken independently by the Trustees. This coordination reduced duplication of effort and increased the cost-effectiveness of the assessment process. The Trustees' assessment used data produced by the Incident Command, the Trustees, and other generally accepted scientific sources.

While proceeding with the injury assessment for the Spill, the Trustees participated in settlement negotiations with Kirby. Doing so is consistent with the OPA regulations, which are intended, in part, to facilitate settlement of damage claims without litigation. As required by the regulations at 15 C.F.R. §990.14 (c)(4), the Trustees retained final authority to make determinations regarding injury and restoration.

As part of the NRDA process, the Trustees settled natural resource damages claims with Kirby and lodged a Consent Decree with the United States District Court for the Southern District of Texas in United States of America and State of Texas v. Kiby Inland Marine L.P., Case No. 3:21-cv-00180 (Settlement). The terms of the Settlement were subject to public notice, was made available for public comment, and the Consent Decree was entered by the Court on September 1, 2021. Under the Consent Decree, Kirby was required to pay the Trustees $1,695,802 (settlement funds) for restoration and associated trustee administrative costs. This natural resource restoration will compensate the public for lost or injured natural resources, and lost natural resource services.

1.8 Public Participation

On July 14, 2021, the Trustees published a Notice of Intent in the Federal Register (Vol. 86, No. 132, pgs. 37122-37124, July 14, 2021). The Notice of Intent stated that, based on Preassessment findings, the Trustees were proceeding with the Injury Assessment and Restoration Planning Phase in accordance with OPA regulations and opening an Administrative Record to facilitate public involvement in the Restoration Planning Phase (see Section 1.9).

The Draft DARP/EA provided information about the nature and extent of natural resource injuries resulting from the Spill, identified and described a reasonable range of restoration projects, and proposed a preferred restoration project to address those injured resources. The Trustees erovided an opportunity for public comment for 30days consistent with Section 1006 of OPA, the NRDA regulations at 15 C.F.R. Part 990, Section 20.44 of OSPRA implementing regulations, and NEPA. Notice of the Draft DARP/EA's availability for public review was

published in a NOAA web posting at https://darrp.noaa.gov/oil-spills/bayport-darp-ea and was made available via NOAA's "Coastal Recovery News and Updates" system. The notice of availability was also published in the Texas Register (Vol. 50, No. 29, pages 4124-4125, July 18, 2025). No comments were received during the review period and the Trustees finalized this DARP/EA without any substantive changes. Additional opportunity for public review will be provided if the Trustees make significant changes to this DARP/EA.

1.9 Administrative Record

An Administrative Record (15 CFR § 990.45) was opened for this case which includes documents that were used or considered by the Trustees during the Injury Assessment and Restoration Planning Phase. These documents are available via postal request at the address listed above or online at:

https://www.diver.orr.noaa.gov/web/guest/diver-admin-record/12302

2 AFFECTED ENVIRONMENT

This chapter provides a general description of the environment and natural resources that were determined to be impacted by the Spill and may be affected by restoration projects.

2.1 Physical Environment

2.1.1 Climate

The climate in the region (approximately 29.5° N latitude) is a maritime climate controlled by the Gulf of America (formerly Gulf of Mexico), classified as subtropical, and characterized by warm and humid summers and mild winters. Air temperatures generally range between the mid-40s (ºF) and mid 90s (ºF) throughout the year. Mean annual rainfall is approximately 50 inches (~127 cm). Both temperature and rainfall peak in summer months. Predominant winds blow from the southeast. Summer winds are moderate and southerly, while winter brings frequent aperiodic strong north winds. The Texas Gulf Coast is also susceptible to tropical weather systems, such as tropical waves, tropical depressions, tropical storms, and hurricanes. These weather systems can produce significant amounts of precipitation over a very short period and are often accompanied by strong winds and storm surges along coastal areas (Barrientos, et al. 2023).

2.1.2 Galveston Bay

Galveston Bay is an estuary or a semi-enclosed coastal body of water that has a free connection to the Gulf of America. Within Galveston Bay, freshwater from the Trinity and San Jacinto rivers and the extensive bayous and creeks of the Houston-Galveston region mix with the salty waters of the Gulf of America. Galveston Bay is the largest estuary in the State of Texas, and the seventh largest in the United States, providing tremendous environmental, economic, and recreational value to the region's residents and wildlife (GBEP 2018).

The Galveston Bay watershed is over 15.3 million acres (61,917 km^2), and the upper Galveston Bay watershed includes the Greater Houston and Dallas-Fort Worth-Arlington metropolitan

areas (GBEP 2018, Figure 2.1). The watershed is divided into two parts. The upper portion of the watershed, pictured in orange in Figure 2.1, covers about 20,000 square miles (52,000 km^2) upstream of the Lake Livingston Dam on the Trinity River and the Lake Houston Dam on the San Jacinto River. The upper watershed is critical because of its freshwater contribution to Galveston Bay. The lower portion of the watershed, downstream of Lake Livingston and Lake Houston, covers approximately 4,000 square miles (10,000 km^2) in the green highlighted areas of Brazoria, Chambers, Fort Bend, Galveston, Hardin, Harris, Liberty, Polk, San Jacinto, and Waller counties (GBEP 2018).

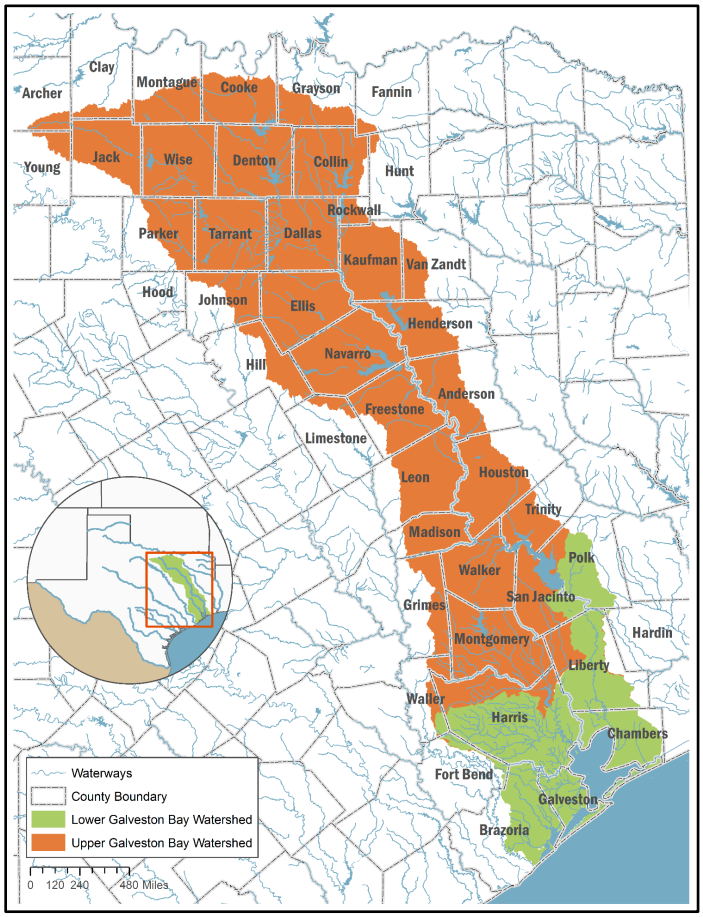

Figure 2.1 The Galveston Bay Watershed (GBEP 2018).

Beyond the watershed, the Galveston Bay system is an interconnected and well-mixed system commonly divided into five main sub-bays (Galveston Bay, Trinity Bay, East Bay, West Bay, and Christmas Bay) and several small, shallow, and productive side bays (Figure 2.2). The main body of Galveston Bay is divided into Upper and Lower segments. The Spill discussed in this document occurred in Upper Galveston Bay.

Overall, the Bay is very shallow (< 10 feet (3 m) water depth) with the exception of the Houston Ship Channel, which is maintained through dredging to a depth of approximately 39 feet (12 m). The Bay receives freshwater inflow from rivers (e.g., Trinity and San Jacinto rivers), bayous (e.g., Dickinson and Cedar Bayous), small tributaries, and stormwater runoff. Approximately

80% of the exchange between the Bay and the Gulf of America is through Bolivar Roads, situated between the Bolivar Peninsula and Galveston Island. Bolivar Roads is also a terminus of the Houston Ship Channel; therefore, it serves as the major inlet through which ships travel to the Port of Houston. Tides in the Bay have relatively low amplitudes, with a mean annual tidal range of less than half a meter.

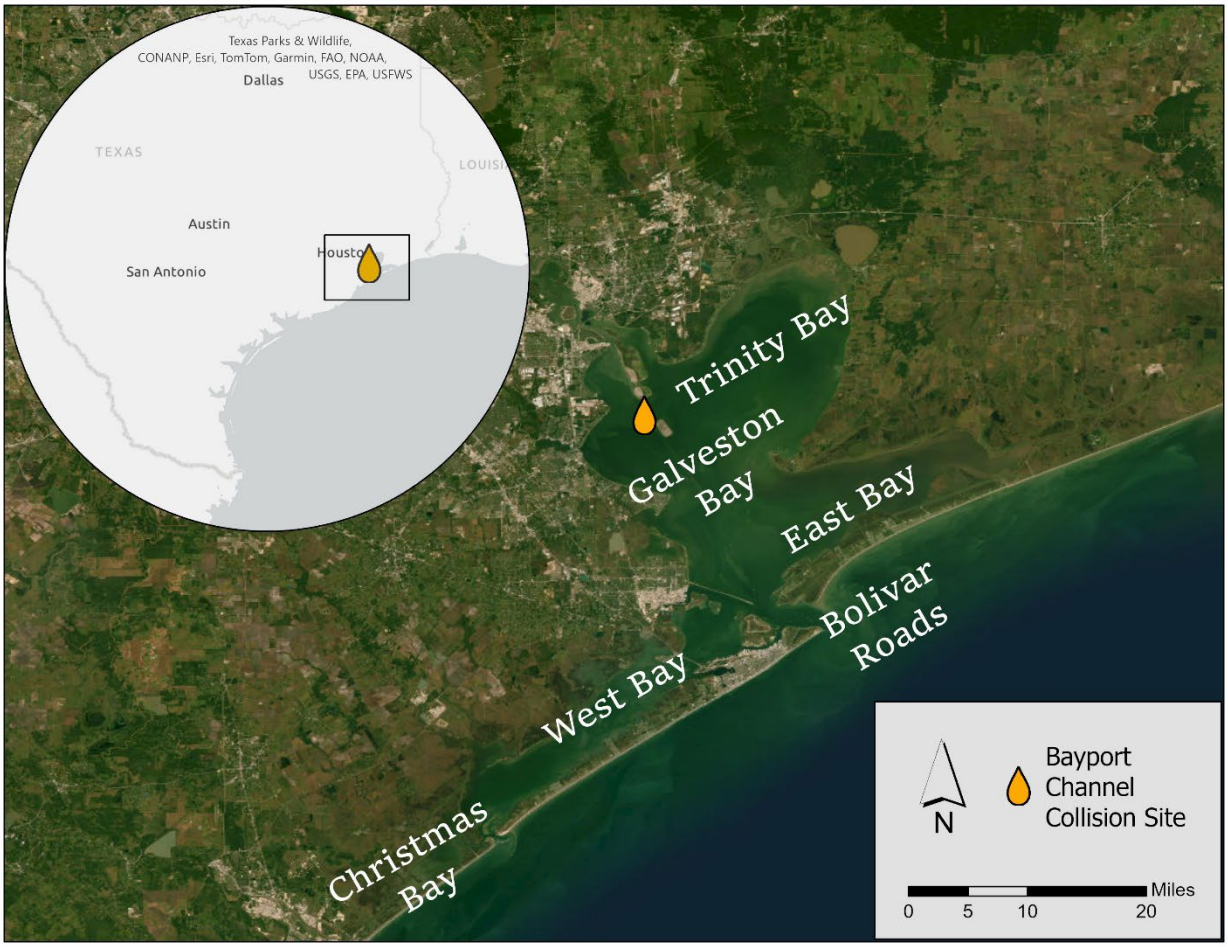

Figure 2.2 Sub-bays within the Galveston Bay system. Inset shows the location relative to the Texas coast.

2.1.3 Land Use

The Collision occurred in upper Galveston Bay in the Houston Ship Channel, near Bayport, Texas, and impacted the western side of the Galveston Bay system. The proposed restoration projects are located on either the western or eastern side of the Galveston Bay system. The western side of the Galveston Bay system is mostly developed with either industrial or residential uses. Limited emergent herbaceous wetlands and sandy shorelines are present in this area. In contrast, the eastern side of the Galveston Bay system is predominately undeveloped or agricultural (i.e. rice and soybean cultivation) with significant stretches of emergent herbaceous

wetlands and pasture with interspersed pockets of low intensity development. Large areas of land have been set aside for conservation and recreation.

2.2 Biological Environment

2.2.1 Shoreline and Bay Habitats

Although heavily influenced by human activities, Galveston Bay and its watershed contain numerous important habitats, including freshwater and estuarine marshes, coastal prairie, open-bay water, open-bay bottom, intertidal mud, sand flats, and oyster reefs. The diversity of habitats and high levels of nutrients found in the bay support diverse and abundant wildlife, including plants, fish, birds, and mammals. In addition, these habitats provide economic goods (e.g., seafood), recreational opportunities, and services, such as nutrient storage and cycling, water filtration, shoreline protection and stabilization, and reduced shoreline erosion. These natural resources and resource services enhance and support the quality of life for people in the Galveston Bay region.

Open-bay, including open-bay water and open-bay bottom, is the largest habitat in the Galveston Bay ecosystem and the habitat most impacted by the Spill. Open-bay water habitat covers approximately 384,000 acres (1,544 km^2) in Galveston Bay and is a critical part of the estuarine ecosystem. Open-bay water is essentially featureless, with the exception of variable horizontal and vertical gradients in parameters such as salinity, temperature, dissolved oxygen, and sediment load. The water column, or pelagic habitat, is used by floating algae, plankton, fishes, invertebrates, marine mammals, birds, and reptiles. Beyond serving as habitat, open-bay water also provides services to humans via transportation, recreation, and food supply. The open-bay bottom includes areas of the bay bottom not covered by oyster reefs or seagrass. In Galveston Bay, the open-bay bottom is dominated by fine-grained silt sediments that are easily resuspended if disturbed. Open-bay bottom habitats support a diverse assemblage of organisms living within or on the sediment, including shrimp, gastropods, bivalves, and worms, as well as many larger animals such as fish and crabs.

Marsh, or emergent wetlands, border shorelines around Galveston Bay. Marsh occurs along the north-to-south salinity gradient in the bay, with salt marsh found in the southern portion of the bay and freshwater marsh farther north in inland areas along bayous and at river mouths. The dominant vegetation species of salt marsh is smooth cordgrass (*Sporobolus alterniflorus*, formerly known as *Spartina alterniflora*). Saltwort (*Batis maritima*), saltgrass (*Distichlis spicata*), and glasswort (*Salicornia* sp.) are also prevalent in salt marshes. Brackish marsh is found in the transitional zone between salt marsh and freshwater marsh and includes black needlerush (*Juncus roemerianus*), common reed (*Phragmites australis*), big cordgrass (*Spartina cynosuroides*), seashore bulrush (*Bolboschoenus robustus*), and Olney bulrush (*Schoenoplectus americanus*). Freshwater marshes are also found within the Galveston Bay watershed in areas such as low depressions; in shallow water along lakes, rivers, or streams; and interdunal areas on Galveston Island and Bolivar Peninsula. Freshwater marsh species include sedges (*Eleocharis* and *Cyperus* sp.), rushes (*Juncus* sp.), coastal arrowhead (*Sagittaria lancifolia*), invasive water hyacinth (*Eichhornia crassipes*), panic grasses (*Rhynchospora* spp.), and spiny aster

(*Chloracantha spinosa*). Freshwater marshes in the Galveston Bay watershed often co-occur with coastal prairie, as "prairie potholes," or wetland depressions.

Marsh provides habitat for many estuarine species, flood control for shorelines, and improved water quality. The channels, pools, and embayments within the marsh provide excellent habitat for fish, invertebrates, and wading birds. Marsh edge in the coastal environment is prime nursery (juvenile) habitat for the commercially important brown and white shrimp (*Farfantepenaeus aztecus* and *Litopenaeus setiferus)* and many species of marine fish. Marsh grasses are rarely consumed directly; however, they provide an important food source to the bay upon decomposition. For decades, the Galveston Bay watershed has been losing marsh habitat, primarily freshwater marsh, due to human activities and sea-level rise. However, within the last decade the rate of loss has slowed considerably due to regulatory protection and habitat-restoration efforts (White et al. 1993, NOAA 2016).

Certain shorelines may not support emergent vegetation and remain as intertidal mudflats, exposed at low tide. Even without vegetation, mudflats are habitat for benthic invertebrates (e.g., worms, snails, and bivalves) that feed on algae or detritus. At high tide, mudflats attract transient biota, such as fish and birds. Marsh and mudflats transition into coastal prairie with grasses and broad-leaf plants. The sediments within the Galveston Bay system support benthic organisms, including various annelid worms, small crustaceans (e.g., amphipods, isopods, copepods, and juvenile decapods), mollusks, and other small bottom-dwellers in salt marshes and unvegetated subtidal sediments. Among these benthic organisms are herbivores (i.e., consume algae or other live plant material), detritivores (i.e., feed on decaying organic matter in surface sediments or sediment-bound nutrients and organic substances), carnivores (i.e., prey on animals), and omnivores (i.e., feed on both plant and animal matter). These organisms provide the nutritional base for developing stages of many finfish and shellfish and, thus, affect all trophic levels in the Galveston Bay system. The activities of benthic organisms are important in wetlands and subtidal habitats for the decomposition and nutrient cycling that occur in these areas. In sum, benthic communities provide important ecological services primarily related to food production, decomposition, and energy cycling that affect nearly all organisms within the Galveston Bay system. Benthic populations have the potential to impact biota in nearly all trophic levels in Galveston Bay.

Oyster reefs are composed of live oysters (i.e., eastern oyster [*Crassostrea virginica]*), clusters of old shells, and other commensal organisms. Oyster reefs were historically found throughout all of Galveston Bay's sub-bays in open-bay areas, at the periphery of marshes, near passes and cuts, along the edges of the Houston Ship Channel, and in both intertidal and subtidal areas (Powell et al., 1994). Their distribution within Galveston Bay has been influenced heavily by human activities (e.g., shell dredging, hydrodynamic alterations, commercial leasing, and restoration) and sediment loading from hurricanes. However, naturally occurring reefs remain in areas of Galveston Bay and its sub-bays. The three-dimensional structure of oyster reefs creates habitat for a diversity of other aquatic organisms, supporting a community of mollusks, crustaceans, worms, and fish. Other services provided by oyster reefs include stabilization of

shoreline areas and improvement of water quality through filtering by live oysters (HARC, Ed. 2020).

2.2.2 Aquatic Biota

Galveston Bay supports a diverse assemblage of aquatic life, including plants (both vascular and non-vascular) and animals (invertebrates, fish, mammals, reptiles, etc.). Composition of aquatic biota varies greatly over space and time (e.g. seasonal patterns), responding to changes in salinity, temperature, and other perturbations throughout the Bay. Several organisms found within the Galveston Bay system are among those vital to the economy of Texas and are a significant element of outdoor recreational opportunities. The waters of Galveston Bay provide habitat for the following commercially and recreationally important invertebrates and fishes: white shrimp, brown shrimp, blue crab (*Callinectes sapidus*), eastern oyster, spotted seatrout (*Cynoscion nebulosus*), sand seatrout (*Cynoscion arenarius*), Atlantic croaker (*Micropogonius undulatus*), red drum (*Scienops ocellatus*), black drum (*Pogonius cromis*), southern kingfish (*Menticirrhus americanus*), Gulf kingfish (*Menticirrhus littoralis*), sheepshead (*Argosargus probatocephalus*), southern flounder (*Paralichthyes lethostigma*), striped mullet (*Mugil cephalus*), Gulf menhaden (*Brevoortia patronus*), and gafftopsail catfish (*Bagre marinus*). Numerous other estuarine and marine biota are also found in the Galveston Bay system, including bay anchovy (*Anchoa mitchilli*), silver perch (*Bairdiella chrysoura*), bull shark (*Carcharhinus leucas*), sheepshead minnow (*Cyprinodon variegatus*), gizzard shad (*Dorosoma cepedianum*), Gulf killifish (*Fundulus grandis*), code goby (*Gobiosoma robustum*), pinfish (*Lagodon rhomboides*), spot (*Leiostomus xanthurus*), silversides (*Menidia* spp.), Gulf flounder (*Paralichthys albigutta*), Spanish mackerel (*Scomberomorus maculatus*), hardhead catfish (*Ariopsis Felis*), bay squid (*Lolliguncula brevis*), hard clam (*Mercenaria mercenaria*), grass shrimp (*Palaemonetes pugio*), and common rangia (*Rangia cuneata*). Kemp's ridley sea turtles (*Lepidochelys kempii*) and green sea turtles (*Chelonia mydas*) are observed frequently in Galveston Bay, foraging seasonally as they migrate along the Texas coast to and from their primary nesting grounds.

Common bottlenose dolphins (*Tursiops truncatus*), hereafter referred to as bottlenose dolphins, are found throughout most bays, sounds, and estuaries of the Gulf of America, and are the most common marine mammal in the Galveston Bay system and nearby coastal waters. Bottlenose dolphins are separated into demographically independent populations, referred to as stocks. In total, there are currently 36 stocks of bottlenose dolphins in the northern Gulf of America. Two stocks are predominantly present in the Galveston Bay system: the Galveston Bay stock and the Gulf of Mexico Western Coastal stock. Within the Galveston Bay system, bottlenose dolphins use open-bay water habitat, with dense congregations often found in and near Bolivar Roads, the main tidal pass to the Gulf of America. This deep, high salinity transition zone, where the estuary and Gulf meet, is used for prey-foraging and likely a place where multiple stocks mix. In addition, bottlenose dolphins utilize other deep channels, such as the Houston Ship Channel, open-bay habitat, and nearshore habitats throughout upper and lower Galveston Bay. There is less evidence of habitat use in Trinity and East Bays. The spatial distribution of bottlenose dolphins in the Galveston Bay system is likely influenced by numerous factors, including

environmental variables (e.g. salinity, temperature, turbidity, and water quality), prey distribution and abundance, predator avoidance, and human disturbance. Additionally, bottlenose dolphin distribution within Galveston Bay changes seasonally, with individuals preferring deeper waters, passes, and channels during winter and bay waters during warmer months.

Many estuarine-dependent species of fish are harvested from Galveston Bay, including flounder, Atlantic croaker, spotted seatrout, sand seatrout, and red drum. In addition, five species of invertebrates (oysters, blue crabs, and three penaeid shrimps) are harvested from the Galveston Bay system. During their juvenile stages, these organisms utilize estuarine habitats, such as marshes, oyster reefs, and mudflats, for feeding and protection. Many species are more abundant in vegetated habitats (e.g. salt marshes), than in subtidal non-vegetated habitats (e.g. mudflats).

Estuarine organisms of commercial, recreational, and ecological importance typically have inshore and offshore components of their life histories. Many species in the Galveston Bay system spawn offshore or near estuary passes, and their larvae or post larvae migrate into estuarine nursery areas to grow and develop prior to offshore migration and maturation. Salt marsh habitat is the primary nursery habitat for many fish and invertebrate species. Other taxa such as birds, reptiles, and mammals also use salt marsh for feeding, refuge, and reproduction.

2.2.3 Essential Fish Habitat

The Galveston Bay system contains areas identified as Essential Fish Habitat (EFH) pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The 1998 generic amendment of the Fishery Management Plans for the Gulf of America prepared by the Gulf of Mexico Fishery Management Council identifies EFH in the Spill and proposed restoration activity areas to be estuarine waters, substrates, and associated biological communities. Under the MSFCMA, wetlands and associated estuarine waters in these areas are identified as EFH for brown shrimp, pink shrimp (*Farfantepanaeus Duorarum*), white shrimp, red drum, Spanish mackerel, grey snapper (*Lutjanus griseus*), lane snapper (*Lutjanus synagris*), cobia (*Rachycentron canadum*), and bonnethead (*Sphyrna tiburo*), bull (*Carcharhinus leucas*), spinner (*Carcharhinus brevipinna*), and blacktip (*Carcharhinus limbatus*) sharks. Table 2.1 provides a more detailed description of EFH utilized by these species at various life stages within the Spill and proposed restoration activity areas.

Table 2.1 EFH requirements for managed species that may occur in the Spill and proposed restoration activity areas.

Species	Life Stages	EFH in Areas of Spill and Proposed Restoration
Brown shrimp	• Post larvae • Juveniles • Subadults	• Water column • Submerged Aquatic Vegetation (SAV) • Emergent Marsh • Oyster Reef • Soft bottom • Sand/shell
Pink shrimp	• Juveniles • Subadults	• SAV • Soft bottom • Sand/shell • Oyster reef
White shrimp	• Post larvae • Juveniles • Subadults • Adults • Spawning adults	• Water column • SAV • Emergent Marsh • Oyster Reef • Soft bottom • Sand/shell
Red drum	• Eggs • Larvae • Post larvae • Early juveniles • Late juveniles • Adults	• Water column • SAV • Emergent Marsh • Soft bottom • Hard bottom • Sand/shell
Spanish Mackerel	• Early juveniles • Late juveniles • Adults	• Estuarine • Water column
Grey Snapper	• Adults	• Hard bottom • Soft bottom • Reef • Sand/shell • Banks/shoals • Emergent marsh

Species	Life Stages	EFH in Areas of Spill and Proposed Restoration
Lane Snapper	• Larvae • Post larvae • Juveniles	• Water column • SAV • Sand/shell • Soft bottom • Banks/Shoals
Cobia	• Eggs • Larvae	• Water column
Bonnethead, bull, spinner, and blacktip sharks	• Neonate • Juvenile • Adult	• Water column • SAV • Mud bottoms • Oyster reefs

2.2.4 Endangered and Threatened Species

The Endangered Species Act (ESA; 16 U.S.C. §§ 1531–1544) was established to protect species vulnerable to extinction, as well as their environments. Marine organisms are under the jurisdiction of NOAA Fisheries, while terrestrial and freshwater organisms are overseen by the United States Fish and Wildlife Service (USFWS). The ESA defines "endangered" as a species in danger of extinction in all or a significant portion of its range. "Threatened" is defined as a species that is likely to become endangered in the foreseeable future. NOAA and USFWS classify any areas that are essential for the conservation and recovery of threatened or endangered species as Critical Habitat.

Numerous endangered and threatened species are seasonal or occasional visitors to the Galveston Bay system. The potential occurrence of federally and/or state listed threatened or endangered wildlife species in the vicinity of the Spill and where the preferred restoration projects are located is summarized in Table 2.2.

Section 7(a)(2) of the ESA of 1973 (16 U.S.C. § 1536(a)(2)) as amended, requires:

> Each Federal agency shall, in consultation with and with the assistance of the Secretary, ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species.

Data regarding federally protected species is based on the USFWS Environmental Conservation Online System (USFWS nd) and the Threatened and Endangered Species and Critical Habitats Under NOAA Fisheries Jurisdiction database (NOAA nd). Data regarding state protected species is based on the Rare, Threatened, and Endangered Species of Texas by County database (TPWD nd).

Table 2.2 Federal and State Endangered and Threatened Species and their critical habitats in the affected environment (as of January 31, 2025). [2]

Species Type	Species	Critical Habitat	Federal Status	State Status
Mammals	West Indian manatee (*Trichechus manatus*)	No	Threatened	Threatened
Birds	Eastern black rail (*Laterallus jamaicensis jamaicensis*)	No	Threatened	Threatened
Birds	Piping plover (*Charadrius melodus*)	Yes	Threatened	Threatened
Birds	Rufia red knot (*Calidris canutus rufa*)	No	Threatened	Threatened
Birds	Eskimo curlew (*Numenius Borealis*)	No	Endangered	Endangered
Birds	Reddish egret (*Egretta rufescens*)	No		Threatened
Birds	White-faced Ibis (*Plegadis chihi*)	No		Threatened
Birds	Wood Stork (*Mycteria americana*)	No		Threatened
Birds	Shallow-tailed kite (*Elanoides forficatus*)	No		Threatened
Birds	Whooping Crane (*Grus americana*)	No	Endangered	Endangered
Reptiles	Green sea turtle (*Chelonia mydas*)	No	Threatened	Threatened
Reptiles	Hawksbill sea turtle (*Eretmochelys imbricata*)	No	Endangered	Endangered
Reptiles	Kemp's Ridley sea turtle (*Lepidochelys kempii*)	No	Endangered	Endangered

[2] Current federally and state listed species lists for Chambers, Galveston, and Harris Counties were accessed on January 31, 2025, at https://tpwd.texas.gov/gis/rtest/ and https://ecos.fws.gov/ecp/report/species-listings-by-state?stateAbbrev=TX&stateName=Texas&statusCategory=Listed and https://www.fisheries.noaa.gov/southeast/consultations/threatened-and-endangered-species-list-texas.

Species Type	Species	Critical Habitat	Federal Status	State Status
Reptiles	Leatherback sea turtle (*Dermochelys coriacea*)	No	Endangered	Endangered
Reptiles	Loggerhead sea turtle (*Caretta caretta*)	No	Threatened	Threatened

2.3 Socioeconomic and Human Use Resources

The five counties bordering the Galveston Bay system are home to approximately 5.4 million people. The Houston Metropolitan Area in Harris County ranks as the fourth largest in the nation, with approximately 4.8 million residents (Pellegrino 2023 and Barrientos 2023). The majority of urban and industrial development around the Galveston Bay system is in Harris County. The other counties have higher levels of agricultural land, wetlands, coastal prairie, and evergreen forest, and substantially lower population densities, with the lowest population density in Chambers County. The population of all five counties has been increasing over time.

2.3.1 Demographics

According to the U.S. Census Bureau American Community Survey Data, the Galveston County population of Texas City-League City census County Division, near the Collision location and some of the proposed restoration sites, is 267,185 and the median household income is reported to be $95,036. The Chambers County population of Anahuac Census County Division, near some of the proposed restoration sites, is 6,799 and the median household income is reported to be $73,717 (United State Census Bureau 2024).

2.3.2 Human Uses

Human uses of Galveston Bay are both economic and recreational. Commercially, the Galveston Bay system is extremely important to the State of Texas for transportation and oil and gas production. Measured by tons of materials transported, the Port of Houston is one of the busiest ports in the country (Port of Houston 2024 and BTS 2022). Many of the area's petrochemical and other industries rely on the Houston Ship Channel, Gulf Intracoastal Waterway, and other navigation channels within the Galveston Bay system for transportation. The 10 oil refineries in the region process approximately 45 percent of the total crude oil production in the state and 14 percent of the total capacity in the country (GHP 2021).

The Galveston Bay system supports a wide range of commercial and recreational fishing. There is a significant recreational fishery for finfish in the area, including spotted sea trout, red drum, and southern flounder. The recreational fishing industry in the area generates an estimated annual economic value of over $150 million (Ropicki et al. 2016).

While there are around a hundred different species commercially harvested each year, most of the landings are made up of only a handful of species. Specifically, shrimp make up 82% of the average (2021-2022) annual landings of 71 million pounds, whereas saltwater fish, oysters, and

crabs combined are only 16% of the total landings (Figure 2.3). The combined monetary value of these recent annual landings is valued at over $204 million (Topping 2023).

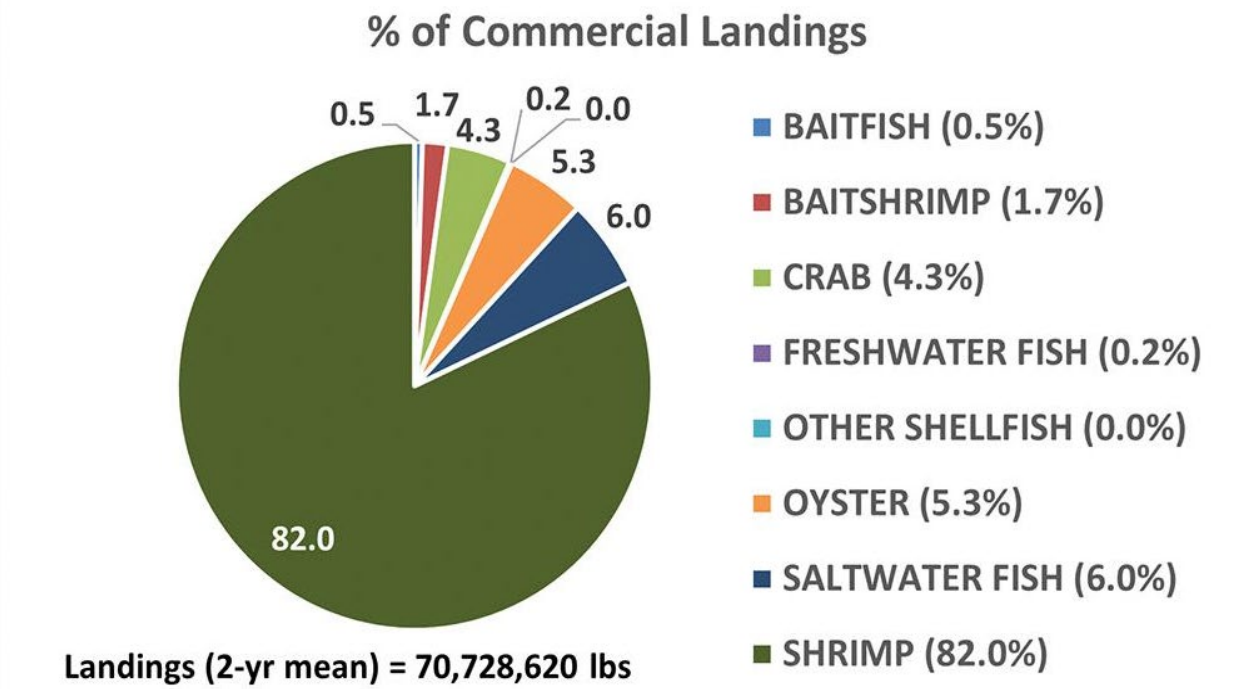

Figure 2.3 Percentage of commercial landings by species category based on the mean landings from 2021-2022 (Topping 2023).

Galveston is also a popular tourist destination, hosting 8.1 million visitors in 2022. In 2022, visitors spent $1.2 billion in Galveston, supporting 11,890 jobs and generating $228.5 million in taxes (GPB 2022). Residents of the Texas Gulf Coast use the lower Galveston Bay watershed for many popular outdoor activities including waterfowl hunting, fishing, swimming, nature viewing, pleasure boating, camping, picnicking, and sightseeing. Bird watching has become very popular along the Texas coast, with over 600 species drawing visitors to the area. Chambers County is visited by tourists primarily for natural attractions such as bird watching at High Island and wildlife viewing at the Jocelyn Nungaray National Wildlife Refuge (formerly Anahuac National Wildlife Refuge). There are many stops around the Galveston Bay system on the Great Texas Coastal Birding Trail which links 500 miles of coastal bird viewing sites from Brownsville to Beaumont (HARC, Ed. 2020).

3 INJURY ASSESSMENT AND QUANTIFICATION

This chapter describes the Trustees' assessment of the nature, degree, and extent of injuries to natural resources and services resulting from the Spill. The chapter begins with an overview of data collected during the Preassessment Phase of the NRDA process. The rest of the chapter describes the Trustees' assessment strategy, including the approaches used to identify and quantify potential injuries.

3.1 Preassessment Activities and Findings

The Trustees initiated Preassessment activities for the discharge shortly after notification of the Collision on May 10, 2019. In accordance with 15 C.F.R. §990.42, the Trustees proceeded with Restoration Planning based on the following determinations:

- Injuries resulted or probably will result from the Spill;
- Response actions did not adequately address or are not expected to address the injuries resulting from the Spill; and
- Feasible primary and/or compensatory restoration projects exist to address the potential injuries.

Information collected during the Preassessment Phase of the Spill is summarized below.

3.1.1 Water Column

Water column, as discussed in this document, is a habitat that consists of the entire volume of water from the surface to the seafloor and includes all plants and animals that use the habitat. During the Preassessment Phase, where possible, the Trustees collaboratively gathered information with the Responsible Party or used data generated from the Incident Command. Information collected included oiling trajectory, shoreline oiling (i.e., SCAT), shoreline types, characteristics of the oil, signs of oiling impacts (e.g., dead wildlife), and other incident response data (e.g., photographs). During data collection, it was noted that in some areas oiling was difficult to observe because of the clear color of the oil, nature of the shoreline, and access limitations (e.g., private property).

The information collected was used to understand the extent of oiling. Signs of oiling impacts (e.g., dead wildlife), characteristics of the oil, and other incident response data provided information on the degree of impact from the Spill. For example, the composition and size of dead organisms collected indicated that Spill impacts extended throughout the water column, from surface water to sediment, and that reformate concentrations in the water column were toxic enough to cause mortality to a range of organisms, including adult fishes. This information demonstrated that it was appropriate to proceed with the injury assessment.

Additional injury categories, including marine mammals, were considered but not pursued.

3.2 Injury Assessment and Quantification

3.2.1 Assessment Strategy

The goal of injury assessment under OPA is to determine the nature, degree, and extent of injuries to natural resources and services resulting from an incident to provide a technical basis for evaluating and scaling restoration projects. After identifying those natural resources likely injured by the Spill, the Trustees considered a number of factors to select appropriate injury assessment procedures for this NRDA. The development of these procedures was primarily based on: (1) information gathered during the Spill response and Preassessment Phases; (2) relevant peer-reviewed literature; and (3) best professional judgment of the Trustees.

The Trustees employed simple, cost-effective procedures for collecting data and assessing injuries to natural resources and the ecological services related to those resources. This included the development of reasonable, protective, and scientifically supported assumptions that allowed for the assessment of injury with less investment of time and money in field or lab-based studies, running extensive modeling, or conducting costly toxicity testing. The quantification of natural resource injuries resulting from the Spill was consolidated into one natural resource category, water column, which encompassed injuries to pelagic and benthic fish and invertebrates.

3.2.2 Assessment Methods and Quantification

The Trustees gathered information about the quantity and characteristics of the material released (i.e. reformate) and evaluated the spatial extent of the area impacted by using a combination of oil trajectory modeling and field observations of dead stranded organisms and impacted shoreline. The Trustees then estimated reformate concentrations within that volume of water, accounting for product weathering (evaporation and dispersion into the water column), to determine whether and where reformate concentrations existed that are known to be lethal to aquatic organisms.

Reformate is a volatile, clear liquid that is generated through the refining process of catalytic reforming. The name reformate does not define a specific chemical composition, as different conditions lead to the production of reformates with slightly different compositions that may contain a range of compounds. The chemical composition of a barge sample from the Spill was therefore used to evaluate the toxicity of the reformate. The dominant chemical components of the spilled reformate were ethylbenzene, xylene, trimethylbenzene, and tetramethylbenzene. The ECOTOXicology Knowledgebase (USEPA nd) was searched for information on mortality endpoints for any life stage of aquatic organisms exposed to these four dominant chemical components of the spilled reformate. Mortality was selected as a standard toxicity endpoint and acute exposures of 24 and 48 hours were selected for initial evaluation due to the volatile nature of the spilled reformate. The majority (> 90%) of the ECOTOX search results were for a standard mortality endpoint: lethal concentration 50 ("LC50"; the aqueous concentration that is expected to kill 50% of exposed organisms); therefore, only LC50 values were used for the injury quantification.

The Trustees considered a range of potential impact areas within the bay and ultimately applied the smallest impact area using a combination of trajectory and oil weathering modeling and field observations. In addition, the impact area was delineated based upon the conclusion that the greatest water column impacts from the Spill would have been in shallow, nearshore areas, including marsh and oyster reef habitat. The Trustees estimated that the area of Galveston Bay impacted by the spilled reformate over a 24-hour period was approximately 1,945 acres (7.87 km^2). A longer 48-hour period was also considered, however, due to the volatility of reformate and its ability to quickly disperse into the water column, the Trustees applied the shorter time period to calculate the injury. To estimate the relative toxicity of the bay water in the impact area, the estimated post-spill reformate levels were compared to the median LC50 value for acute exposures for aquatic organisms over a 24-hour period. Through this assessment, the Trustees concluded that the area of bay water estimated to be impacted by the Spill had concentrations of

reformate throughout the water column, from surface to sediment, capable of causing mortality to 50% of the organisms present.

A Habitat Equivalency Analysis (HEA) is an accounting procedure that allows parties to identify 'debits' (estimating habitat injuries or other resource service losses) caused by exposure to oil or a hazardous substance, and restoration 'credits' required to compensate for assessed injuries or losses (NOAA 2006). The Trustees used a HEA to quantify interim service losses (i.e., service losses incurred from the time of injury until recovery of the resource to baseline condition) for water column habitat impacted by the Spill. Interim service losses were quantified in terms of discounted service acre years (DSAYs), where a service acre year is the value of ecosystem services provided by one acre of a given habitat over the course of one year. The input parameters for the HEA included total acres of injured habitat, the initial level of service losses (50%), and the recovery curve of service flows over time. The HEA estimates 930 DSAYs were lost due to the Spill.

A more detailed description of the Trustee's water column injury assessment can be found in the Trustees' *Bayport Channel Collision Oil Spill: Water Column Injury Assessment Report* (NOAA 2021), found in the Administrative Record (hyperlink).

4 RESTORATION PROJECTS

The goal of restoration under OPA is to compensate the public for injuries to natural resources and their services resulting from an oil spill or the threat of an oil spill. This goal is achieved through the return of the injured natural resources and their services to baseline conditions and compensation for interim losses from the date of an incident until recovery. This section (1) discusses the evaluation standards used to assess restoration projects, (2) evaluates a reasonable range of restoration projects (to be funded by the Settlement with Kirby) to restore the natural resources and resource services injured by the Spill, and (3) identifies the Trustees' preferred project(s).

4.1 Restoration Strategy

Restoration is defined as primary or compensatory. Primary restoration is restoration that restores injured natural resources and services to baseline condition (i.e., the condition prior to the discharge of oil product). Compensatory restoration addresses interim losses of natural resource services from the time of initial injury until recovery of the natural resources to baseline condition. Natural recovery, in which no human intervention is taken to restore the injured resources, is considered as primary restoration and may be appropriate where feasible or cost-effective active primary restoration projects are not available, or where the injured resources would recover relatively quickly without human intervention. The scale of the compensatory restoration required depends on the nature, extent, severity, and duration of the resource injury.

Upon completion of emergency response and cleanup activities following the Spill, the Trustees determined that, due to the rapid dispersion of the product spilled and its toxicity to aquatic organisms throughout the water column, natural recovery would not contribute significantly to the recovery of the organisms injured in the affected area. Thus, the Settlement consists of funds

allocated for compensatory restoration. The Trustees' Restoration Planning Phase, as well as the restoration projects identified and evaluated by the Trustees to compensate for natural resources resulting from the Spill, are described below.

4.2 Developing Restoration Projects

OPA and NEPA require the Trustees to develop a reasonable range of restoration projects before selecting preferred project(s). The Trustees identified a reasonable range of restoration projects consistent with the Trustees' goal to restore, rehabilitate, replace, enhance, or acquire the equivalent of the injured resources and resource services by improving habitat and ecological services for aquatic organisms impacted by water column injuries. Each project must be designed so that the preferred project(s) would make the environment and public whole and meet OPA evaluation standards. The sections below discuss how the Trustees evaluated potential restoration projects.

4.2.1 Evaluation standards used to assess restoration projects

The OPA NRDA regulations (15 CFR §990.54 (a)) identify six evaluation standards that Trustees are required to utilize in the identification of preferred restoration projects. Additional evaluation standards can supplement these standards, as appropriate.

The required evaluation standards are listed below, and are not ranked in order of priority:

1. ***The cost to carry out the project (cost effective):*** The benefits of a project relative to its cost are a major factor in evaluating restoration projects. In addition, the Trustees must consider the project's total cost. Factors that can affect and increase the costs of implementing the restoration alternatives may include project timing, access to the project site (for example with heavy equipment), obtaining state or federal permits, acquiring the land needed to complete a project, and potential liability from project construction.
2. ***The extent to which each project is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses (meets trustees goals)***: Projects that restore, rehabilitate, replace, enhance, or acquire the equivalent of the resources and services injured by the spill are preferred to projects that benefit other comparable resources or services. Trustees must consider the potential relative productivity of the restored habitat, future site management issues, and compliance with all applicable federal or state laws and regulations.
3. ***The likelihood of success of each project (likelihood of success):*** The Trustees consider technical factors that represent risk to successful project construction, project function, or long-term viability of the restored habitat. This includes site-specific factors, such as whether a project is technically and procedurally sound, utilizes proven methods, involves sufficient acreage that is suitable and available for project implementation, and whether there are potential institutional or legal constraints.

4. ***The extent to which each project will prevent future injury as a result of the spill and avoid collateral injury as a result of implementing the project (avoids or minimizes adverse impacts):*** Projects should avoid or minimize adverse impacts to the environment and the associated natural resources. Projects should not contaminate the surrounding area or conflict with the viability of endangered species populations. Projects should be compatible with surrounding land use.
5. ***The extent to which each project benefits more than one natural resource and/or service (multiple resource benefits):*** This concept is related to the interrelationships among natural resources and between natural resources and the services they provide. Projects that provide benefits to more than one resource and/or service yield more benefits.
6. ***The effect of each project on public health and safety (public health and safety):*** Projects that would negatively affect public health or safety are not appropriate.

The Trustees evaluated restoration projects in two phases. The first phase of the process narrowed the field of potential projects that most closely met the six OPA NRDA evaluation standards. This first evaluation phase focused Trustees' information gathering efforts on the projects with the greatest potential to meet restoration goals. As a result, all projects evaluated in this document demonstrate general alignment with the evaluation standards outlined in the OPA NRDA regulations.

The second phase of the process applied additional case-specific evaluation standards adopted by the Trustees to the projects described in this document, including:

7. ***Time to provide benefits****:* The Trustees considered how soon proposed restoration projects would provide benefits to the target resource or public. Projects where permitting or design is underway or complete were preferred.
8. ***Duration of benefits****:* The Trustees considered the expected duration of benefits from the proposed restoration projects. Projects expected to have longer term benefits were favored over those with shorter term benefits.
9. ***Opportunities for collaboration****:* The Trustees considered the possibility of enhancing the benefits of restoration projects by coordinating proposed restoration projects with ongoing or proposed projects or programs. Proposed restoration projects that were components of existing regional plans, or that leveraged external funding, were regarded more favorably.
10. ***Total cost and accuracy of estimate****:* The Trustees prioritized restoration projects that included a detailed budget in the project proposal.
11. ***Maintenance requirements****:* Trustees considered future maintenance needs for proposed restoration projects. If future operations, maintenance, or monitoring is required, projects that have funding sources and entities responsible for these duties identified in the project proposal were preferred.
12. ***Compliance with federal, state, and local laws and policies***. The Trustees considered whether the project complies with all relevant laws and policies and ensures there are no known reasons for permitting delays.

Through the application of the OPA evaluation standards and case-specific evaluation standards, the Trustees determined whether projects within the reasonable range were preferred or not preferred.

4.2.2 Evaluating the potential restoration projects against the evaluation standards

In initiating the Restoration Planning Phase for injuries resulting from the Spill, the Trustees limited the geographic scope of the potential restoration projects considered to those within the Galveston Bay system. The following subsections discuss a reasonable range of possible projects for restoration and an evaluation of each project as compared to the evaluation standards described above. A summary of the evaluation is shown in Table 4.1.

Table 4.1 Evaluation of the proposed projects based on the OPA and case specific evaluation standards.

Evaluation Standards	No Action	Gordy Marsh Living Shoreline	Swan Lake Marsh Restoration	Landscape Scale Oyster Restoration
Cost to Implement[3]	$0	$1,250,000	$1,250,000	$1,250,000
Cost-Effective	Yes	Yes	Yes	Yes
Meets Trustees' Goals	No	Yes	Yes	Yes
Likelihood of Success	No	Yes	Yes	Yes
Avoids or Minimizes Adverse Impacts	Yes	Yes	Yes	Yes
Multiple Resource Benefits	No	Yes	Yes	Yes
Public Health and Safety	Negligible	Benefits	Benefits	Benefits

[3] Cost to implement is the trustees' costs to implement the project.

Evaluation Standards	No Action	Gordy Marsh Living Shoreline	Swan Lake Marsh Restoration	Landscape Scale Oyster Restoration
Time to Provide Benefits	N/A	Ready for construction	Additional planning needed	Additional planning needed
Duration of Benefits	No benefits	Approximately 30 years	Approximately 30 years	Approximately 20-25 years
Opportunity for Collaboration	No	Yes	Yes	Yes
Total Cost and Accuracy of Estimate	No cost	Based on engineering and design opinion of probable costs	Based on feasibility study opinion of probable costs	Based on average cost per acre of recent projects in the area
Maintenance Requirement	None	None	None	None
Compliance with Applicable Federal, State, and Local Laws and Policies	Yes	Yes	Yes	Yes

A more detailed evaluation of the proposed projects based on the evaluation standards, and the rationale for selecting Gordy Marsh Living Shoreline as the preferred project, is provided in the sections below.

4.2.3 No Action/Natural Recovery Alternative

NEPA requires the Trustees to consider a "no action" alternative, and the OPA regulations require consideration of the "natural recovery" option. These options are equivalent. Under this alternative, the Trustees would take no direct action to restore, rehabilitate, replace, or acquire natural resources or services equivalent to those lost due to the Spill. The Trustees' assessment of natural resource injuries indicates that losses have occurred due to the Spill. Response actions

will allow the injured resource to recover, but these actions will not compensate the public for the resource services lost over time during the period of recovery following the Spill. Compensation serves to make the public and the environment whole. OPA entitles the public to compensation for such losses based on actions that restore, replace, or provide services equivalent to those lost. As evidenced by the restoration projects identified in developing this DARP/EA, there are cost-effective and appropriate opportunities to restore, replace, or provide services equivalent to those lost due to the Spill. A no action alternative would entail no costs, however, under the no action alternative, restoration needed to make the environment and public whole would not occur. This is inconsistent with the obligation to attain both recovery of natural resources and compensation for the public under OPA. Thus, the Trustees determined that the no action alternative (i.e., no restoration) should be rejected on that basis. However, as required under OPA and NEPA, the no action alternative is evaluated in this DARP/EA.

4.2.4 Gordy Marsh Living Shoreline Project

The Gordy Marsh property is located on the eastern side of the Galveston Bay system in Trinity Bay. The property consists of 1,739 acres of high-quality, tidally-influenced wetland and coastal prairie habitats. The property is managed by GBF through a conservation easement that ensures the property's ecological services are protected into the future. The conservation easement on the property restricts future land uses and protects the property against man-made threats, but this legal protection does not prevent natural forces from degrading the existing shoreline habitats. These ecologically valuable habitats are threatened by erosional forces that have caused 1-2 meters of shoreline erosion annually along the eastern shoreline of Trinity Bay (Caudle and Paine 2024). This erosion threatens the health of coastal wetland, marsh, and upland habitats located along the shoreline, including those at Gordy Marsh. The construction of a breakwater is therefore an important restoration effort, which would provide multiple natural resource and resource service benefits by protecting the property's imperiled habitat types.

This project proposes to protect and restore Gordy Marsh in two phases. The first phase is the construction of 9,000 linear feet of breakwater, which will protect wetland and coastal prairie habitat that would otherwise be subject to harm from erosion. In the second phase, sediment is expected to accumulate behind the breakwater, allowing for the creation of up to 16 acres of intertidal wetland habitat through the planting of salt marsh grasses. (Figure 4.1). Long-term erosion control would be accomplished as the nearshore breakwater protects the wetlands and coastal prairie habitat. The Trustees would work with GBF to implement this project.

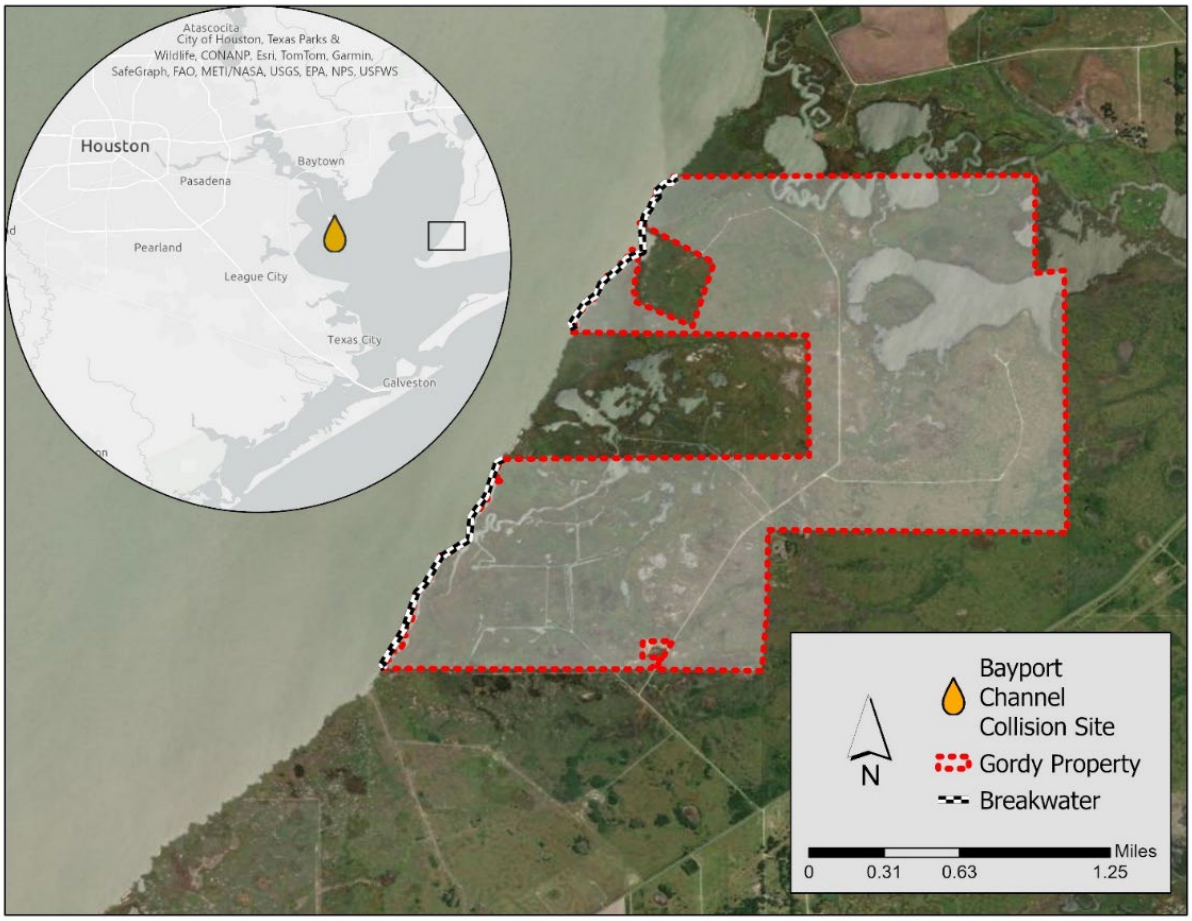

Figure 4.1 Gordy Marsh property boundary and location of potential breakwaters. Inset shows the restoration site (black rectangle) relative to where the Collision occurred.

Cost Effectiveness: The total estimated budget for this project is $6.5 million to construct a breakwater to protect and conserve approximately 33 acres of high-quality, tidally-influenced wetland and coastal prairie habitat and to plant up to 16 acres of salt marsh grasses in the area behind the breakwater structure. The Trustees have allocated $1,250,000 to the overall project. This project would utilize existing work and leverage multiple funding sources to increase the project's cost effectiveness.

Meets Trustees' goals: This project has a clear nexus to the Spill (Figure 4.1 inset) since it is located within the Galveston Bay system and aims to restore resources similar to those injured by the Spill (i.e. water column). Marsh restoration is effective because it provides food, habitat, and water quality functions to the aquatic environment. Salt marshes are often referred to as "nurseries" because high numbers of juvenile fish and invertebrates use these coastal landscapes to escape predation and to forage and thus, marshes support a higher abundance of organisms compared to water column habitats. Additionally, salt marshes filter out excess nutrients and sediments entering the bay system, thereby improving the quality of the waters that surround them.

Likelihood of success: This project would protect and enhance conserved lands using techniques that have been proven effective and are technically feasible. The project would be implemented by GBF, an organization with extensive experience at successfully implementing this type of restoration in the Galveston Bay system including Trinity Bay. GBF has secured funding for the portions of the project not covered by these NRDA funds.

Avoids or minimizes adverse impacts: Aside from the potential for minor disturbances during construction, this project is not expected to cause substantive collateral injury to natural resources. Conversely, this project would provide environmental benefits by restoring salt marsh and preventing marsh and shoreline retreat.

Multiple resource benefits: The restored salt marsh would provide a wide range of benefits, including foraging habitat for birds and ecological services to aquatic organisms such as invertebrates, fish, and shrimp. The breakwater and restored marsh would provide a buffer from storm surge protecting the adjacent coastal prairie and associated biota (birds, mammals, reptiles, etc.). Additionally, the salt marsh would filter nutrients and pollutants from runoff and sequester carbon providing ecosystem wide benefits.

Public health and safety: This project would minimize adverse impacts to public health and safety during construction by following best management practices. In addition, construction of the breakwaters would benefit health and safety by protecting surrounding areas from wave action and erosion. This project would improve coastal resiliency.

Time to provide benefits: GBF has a completed design plan and has obtained all necessary permits. All funding has been secured and this project is ready to begin construction.

Duration of benefits: The project is predicted to have a lifespan of approximately 30 years.

Opportunities for collaboration: This project was listed as a Tier 1 project (R1-4) in the 2019 Texas Coastal Resiliency Master Plan, which was developed in consultation with coastal and environmental experts to identify opportunities to improve the Texas coast. GBF is working with the GLO through their Coastal Erosion Planning and Response Act (CEPRA) and Gulf of Mexico Energy Security Act (GOMESA) programs to implement this project which presents an opportunity for the Trustees to collaborate across agencies and within the community.

Total cost and accuracy of estimate: A detailed engineer's opinion of probable cost was generated and is consistent with the Trustees expectations for a project of this nature. The opinion of probable costs is one of the most accurate ways to obtain a cost estimate for this type of project.

Maintenance requirements: No maintenance is expected for this project.

Compliance with federal, state, and local laws and policies: This project complies with all federal, state, and local laws and policies.

The Trustees have therefore selected the Gordy Marsh Living Shoreline as the preferred restoration project. The estimated total budget for this project is $6.5 million. Engineering and

design is complete and permits have been obtained. With the $1,250,000 contribution of settlement funds, all funding has been secured and construction is expected to begin in 2026. . The Trustees considered this project using the OPA evaluation standards and the Trustees' additional case-specific evaluation standards and concluded that this project aligns favorably with these evaluation standards. This type and scale of restoration project will provide necessary compensation for water column injuries caused by the Spill with the lowest risk of delay and highest likelihood of success. The Trustees believe the project meets their goals and objectives for restoration (15 CFR § 990.54 (a)(2)).

4.2.5 Swan Lake Marsh Restoration Project

Swan Lake is located on the western side of the Galveston Bay system, southwest of Texas City, Texas and west of Bolivar Roads. Swan Lake is bordered by petrochemical companies and serves an important role of filtering runoff and removing excess nutrients before they enter the Bay. Swan Lake is separated from the Galveston Bay system by a series of small shell islands. The shell islands and the western and southern wetlands of Swan Lake are tidally influenced due to Campbell Bayou that connects Swan Lake with the Galveston Bay system. The Texas Colonial Waterbird Society has designated the shell islands of Swan Lake as the Swan Lake Bird Rookery. This bird rookery serves as a breeding ground for birds including gull-billed tern (*Gelochelidon nilotica*), Forster's tern (*Stema forsten)*, black skimmer (*Rynchops nigra*), and various gulls, herons, and egrets. Swan Lake waters are critical habitat for various species designated as threatened or endangered, including the white-faced ibis and reddish egret.

This project would create up to 185 acres of marsh in Swan Lake of the Galveston Bay system (Figure 4.2). Marsh creation would occur through the placement of sediment from an offsite area. The sediment would be used to fill submerged areas in Swan Lake to elevations suitable to support intertidal wetlands and planting of native marsh vegetation (e.g., smooth cordgrass) with the goals of increasing tidal exchange and creating a sustainable marsh, thereby increasing productivity in the area. The project would convert shallow open water to marsh, optimizing wetland habitat while minimizing impacts to existing habitat and organism usage. The Trustees would work with GLO's CEPRA program to implement this project.

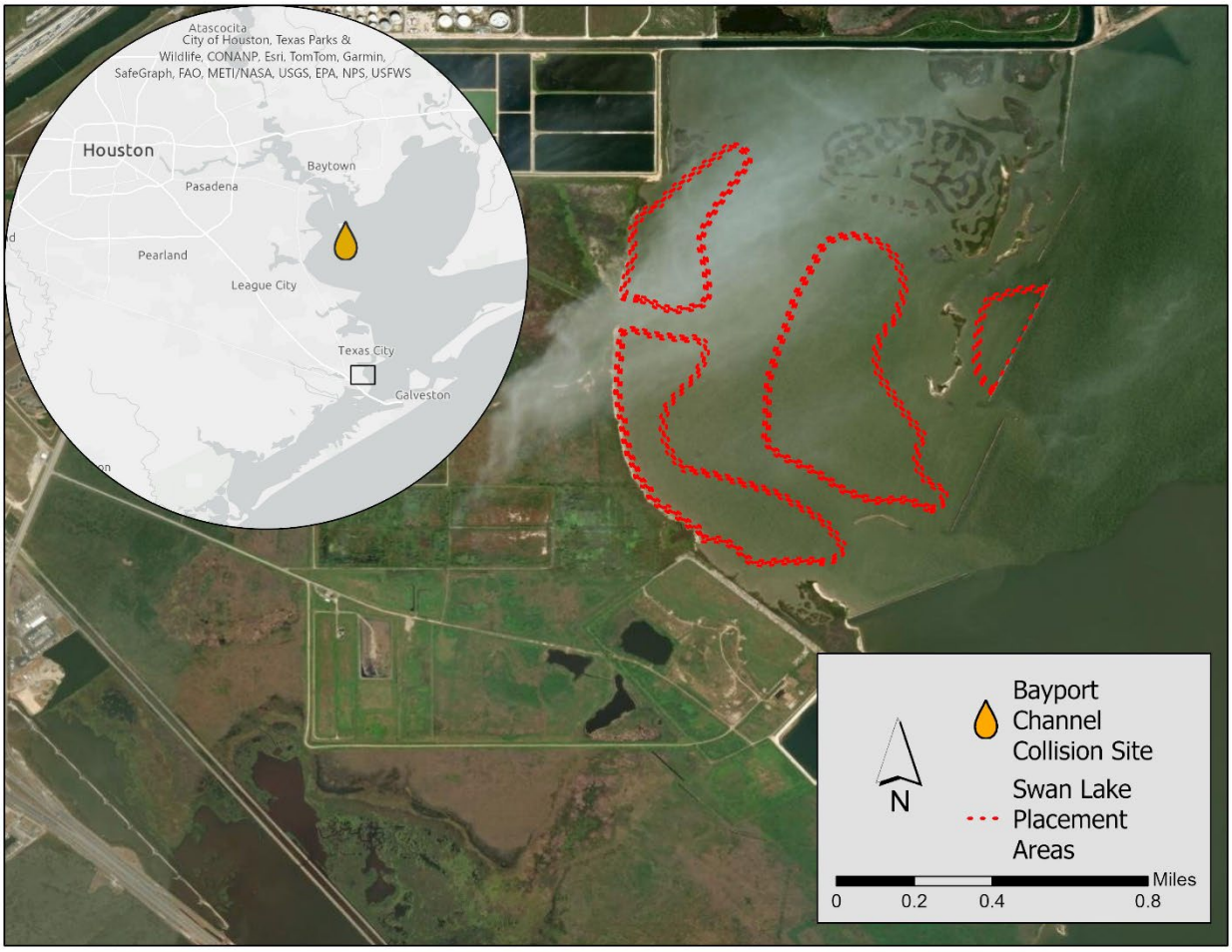

Figure 4.2 Swan Lake dredge material placement areas. Inset shows the restoration site (black rectangle) relative to where the Collision occurred.

Cost Effectiveness. The total estimated budget for this project is $14.7 million to create approximately 185 acres of tidally influenced marsh habitat. The Trustees would allocate $1,250,000 to the overall project. This project would utilize existing work and leverage multiple funding sources to increase the project's cost effectiveness.

Meets Trustees' goals: This project has a clear nexus to the Spill (Figure 4.2 inset) since it is located within the same bay system and aims to restore resources similar to those injured by the Spill (i.e. water column). Marsh restoration is effective because it provides food, habitat, and water quality functions to the aquatic environment. Salt marshes are often referred to as "nurseries" because high numbers of juvenile fish and invertebrates use these coastal landscapes to escape predation and to forage and thus, marshes support a higher abundance of organisms compared to water column habitats. Additionally, salt marsh will filter out excess nutrients and sediments entering the bay system, thereby improving the quality of the waters that surround them.

Likelihood of Success: This project would create marsh habitat using techniques that have been proven effective and are technically feasible. The project would be implemented by GLO, an organization with extensive experience at successfully implementing this type of restoration across the Texas coast. A significant portion of the funding needed for this project has already been secured.

Avoids or minimizes adverse impacts: Aside from the potential for minor disturbances during construction, this project is not expected to cause substantive collateral injury to natural resources. Conversely, this project would provide environmental benefits by restoring salt marsh which will protect the upland areas from storm surge.

Multiple Resource Benefits: The restored marsh would provide a wide range of benefits, including foraging habitat for birds and ecological services to aquatic organisms such as invertebrates, fish, and shrimp. The restored marsh would provide a buffer from storm surge protecting the adjacent coastal prairie and associated biota (birds, mammals, reptiles, etc.). Additionally, the salt marsh would filter nutrients and pollutants from runoff and sequester carbon providing ecosystem wide benefits.

Public health and safety: This project would minimize adverse impacts to public health and safety during construction by following best management practices. In addition, construction of the marsh would benefit health and safety by protecting surrounding areas from wave action and erosion. This project would improve coastal resiliency.

Time to provide benefits: This project has secured the majority of the funding needed. There are still changes being made to the design of the project. The project still needs to finish the engineering and design and obtain permits before it is ready for construction.

Duration of benefits: The project is predicted to have a lifespan of approximately 30 years.

Opportunities for collaboration: This project allows collaboration with GLO's CEPRA program. Restoration efforts would be supported by Malone Services, New Amity, Bow Sun, and Tex-Tin NRDA settlement funds, a settlement from the Oil Spill Liability Trust Fund for Galveston Bay Mystery Spills NRDA case, GOMESA funds, and the National Fish and Wildlife Fund Gulf Environmental Benefit Fund.

Total cost and accuracy of estimate: An opinion of probable cost was generated from a feasibility study and is consistent with Trustees expectations for a project like this. However, there are still changes being made to the design of the project which are likely to affect the accuracy of this estimate.

Maintenance requirements: No maintenance is expected for this project.

Compliance with federal, state, and local laws and policies: This project complies with all federal, state, and local laws and policies.

The total estimated budget for this project is $14.7 million. Engineering and design is in progress; however, permits are still needed. The timeline to begin construction is uncertain. The

Trustees considered this project using the OPA evaluation standards and the Trustees' additional case-specific evaluation standards. The Trustees concluded that this project should be a non-preferred restoration project due to still being in the design phase which will increase the time to benefits.

4.2.6 Landscape Scale Oyster Restoration Project

The Galveston Bay system once had an abundance of oyster reefs, but they have since been declining over the last few decades due to overharvesting, drought, disease, and burial from storms. These reefs have many ecological benefits because they provide habitat for fish and invertebrates, improve water quality by filtering algae and pollutants, and protect adjacent shorelines and uplands from storm surge. Numerous restoration projects have been completed in the Galveston Bay system through partnerships with groups such as TPWD, GBF, and The Nature Conservancy. These projects are creating a network of connected reefs to increase oyster population sustainability and oyster habitat resiliency through larval supply and transport.

This project would create up to 50 acres of oyster reef habitat in upper Galveston Bay (Figure 4.3). Oyster reef creation would occur through the placement of cultch material which provides attachment sites necessary for oyster recruitment and settlement. Oysters are reasonably expected to settle on this material because the Galveston Bay system has an abundance of oyster larvae, but a shortage of hard substrate (TPWD n.d.). Resiliency, sea level rise, and other environmental factors would be considered during the engineering and design portion of the project. This reef would be non-harvestable and would provide a protected source of broodstock that could connect and enhance oyster populations in surrounding harvestable areas. Reef structures would be built perpendicular to the dominant current direction to facilitate larval supply and transport to other nearby reefs. The Trustees would work with TPWD's Restoration and Artificial Reefs Team to implement this project.

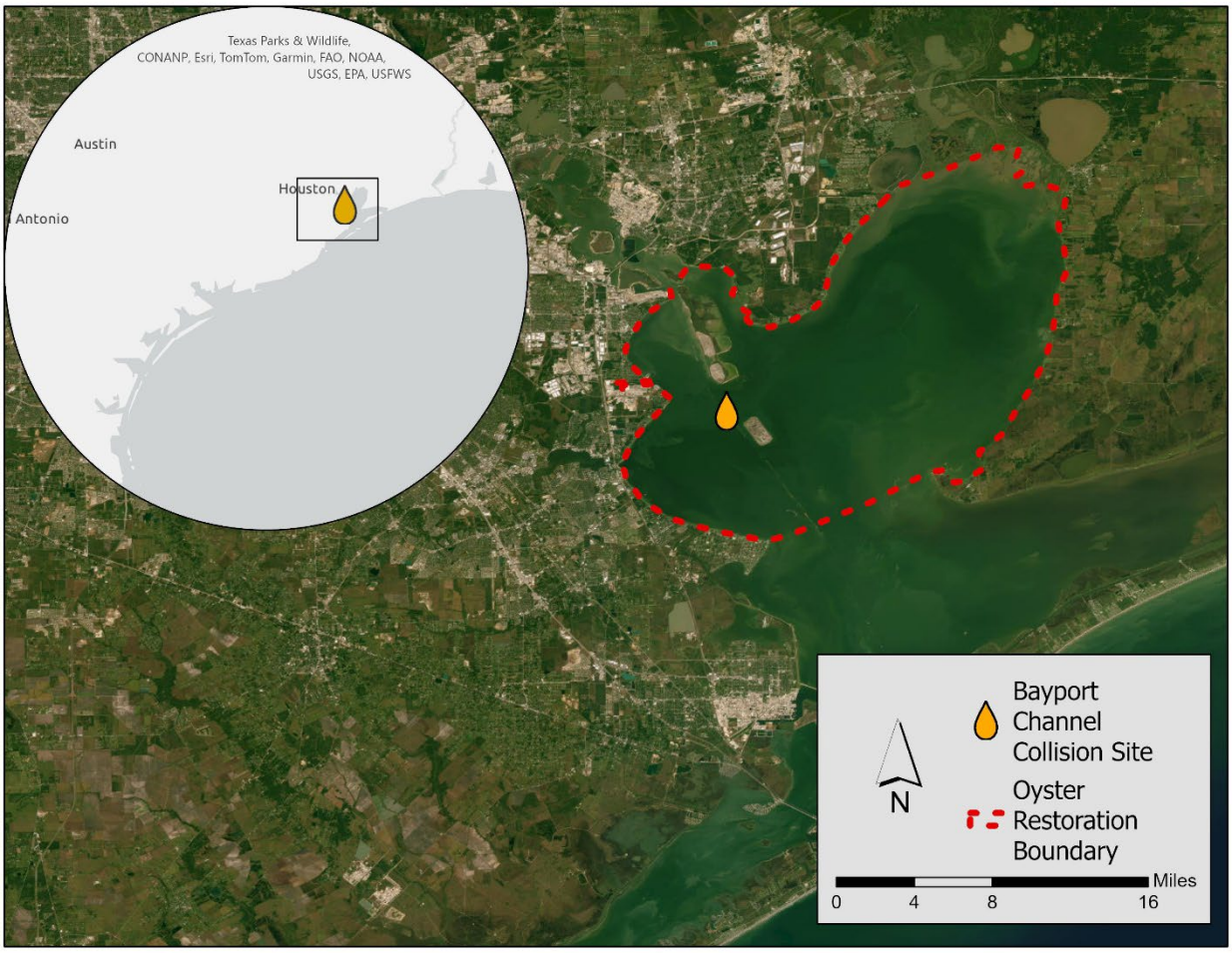

Figure 4.3 Landscape Scale Oyster Restoration in Galveston Bay location boundary in relationship to the Bayport Channel Collision site. Inset shows the restoration site (black rectangle) relative to where the Collision occurred.

Cost Effectiveness: The total estimated budget for this project is $9.5 million to create approximately 50 acres of oyster reef habitat. The Trustees would allocate $1,250,000 to the overall project. This project would utilize existing work and leverage multiple funding sources to increase the project's cost effectiveness.

Meets Trustees' goals: This project has a clear nexus to the Spill (Figure 4.3 inset) since it is located within the same bay system and aims to restore resources similar to those injured by the Spill (i.e. water column). Oyster restoration is effective because it provides food, habitat, and water quality functions to the aquatic environment. Animals inhabiting oyster reefs are similar in variety to those that inhabit the water column, however, oyster reefs support a higher abundance compared to water column habitats. Additionally, oyster reefs filter out excess nutrients, thereby improving the quality of the waters that surround them.

Likelihood of Success: This project would create oyster reef habitat using techniques that have been proven effective and are technically feasible. The project would be implemented by TPWD,

an organization with extensive experience at successfully implementing this type of restoration across the Texas coast. Funding for the portions of the project not covered by these settlement funds has been secured by TPWD.

Avoids or minimizes adverse impacts: Aside from the potential for minor disturbances during construction, this project is not expected to cause substantive collateral injury to natural resources. Conversely, this project would build on previous and ongoing restoration efforts in the Galveston Bay system to improve resiliency of the oyster habitat and the aquatic species that depend on it.

Multiple Resource Benefits: The restored oyster reef would provide a wide range of benefits, including foraging and refuge habitat to fish and invertebrates. The restored oyster reef would help to attenuate wave energy, slowing erosion and helping to reestablish fringing marsh, in and around nearby shorelines. Additionally, the oysters would filter algae and excess nutrients from the water, improving water quality for the entire ecosystem. Finally, this project would enhance the oyster population throughout the bay by producing broodstock that could settle in other areas.

Public health and safety: This project would minimize adverse impacts to public health and safety during construction by following best management practices. In addition, construction of the reef would benefit health and safety by protecting surrounding areas from wave action and erosion. This project would improve coastal resiliency.

Time to provide benefits: This project has secured funding to restore approximately 50 acres but is scalable, and additional oyster reef could be created if settlements funds were provided. It is currently in the site selection phase. The project still needs to complete engineering and design, obtain permits, and solicit construction bids prior to construction.

Duration of benefits: The project is predicted to have a lifespan of approximately 20-25 years.

Opportunities for collaboration: This project allows for collaboration with TPWD and the *Deepwater Horizon* Texas Trustee Implementation Group. Restoration efforts would be supported by Deepwater Horizon Oil Spill Texas restoration area funds as stated in the D*eepwater Horizon* Texas Trustee Implementation Group Final Restoration Plan/Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds (DWH TX TIG 2022).

Total cost and accuracy of estimate: An estimate of project costs was generated based on the average cost per acre of other recently restored oyster reefs in the area.

Maintenance requirements: No maintenance is expected for this project.

Compliance with federal, state, and local laws and policies: This project complies with all federal, state, and local laws and policies.

The total estimated budget for this project is $9.5 million. Site selection is in progress, however, engineering and design and permits are still needed. The timeline to begin construction is uncertain. The Trustees considered this project using the OPA evaluation standards and the

Trustees' additional case-specific evaluation standards. The Trustees concluded that this project should be a non-preferred restoration project due still being in the design phase which will increase the time to benefits.

4.3 Preferred Restoration Project

Based on the evaluation standards analysis required by OPA (summarized in Table 4.1), the Trustees preferred project is the Gordy Marsh Living Shoreline project because it meets the Trustees goals, is sufficient to compensate for injuries to natural resources caused by the Spill, is expected to provide benefits in a timely manner, and has an engineer's option of probable costs. This project is preferred over the Swan Lake Marsh Restoration and Landscape Scale Oyster Restoration projects because the injuries to natural resources and services would be restored more quickly than the non-preferred projects. Earlier implementation of a project increases the restoration benefits provided by the project. Additionally, the Gordy Marsh Living Shoreline project has the most accurate cost estimate.

5 ENVIRONMENTAL IMPACTS OF UNDERTAKING THE PREFERRED RESTORATION PROJECT

NEPA requires that the environmental impacts of a proposed federal action be considered before implementation (42 U.S.C. §4321). This section addresses the potential environmental consequences of the Trustees' selection of a no action alternative and the preferred restoration project. The NEPA evaluation for the other two projects are incorporated herein by reference below. Generally, when it is uncertain whether a project would have a significant impact, federal agencies begin the NEPA planning process by preparing an environmental assessment. Federal agencies will publish the assessment and then review public comments prior to making a final determination. Depending on whether an impact is considered significant, an EIS or a Finding of No Significant Impact would be issued.

In undertaking their NEPA analysis, the federal Trustees evaluated the potential significance of the preferred project, considering both the potentially affected environment (context) and degree of the effects (intensity). For the preferred project considered in this DARP/EA, the appropriate context for considering potential significance of the project is at the local or regional level, as opposed to national, or worldwide. Intensity refers to the severity of impact. This DARP/EA, in its entirety, is intended to accomplish NEPA compliance by summarizing the current environmental setting of the proposed restoration, describing the purpose and need for restoration, identifying an alternative project, assessing the environmental consequences of the no action alternative and the preferred restoration project, and providing an opportunity for public participation in the decision-making process.

The Trustees evaluated the potential for no action alternative and the restoration activities associated with the preferred project to impact the following: the physical environment (air and noise pollution and water quality), the biological environment (vegetation, aquatic habitat, fisheries and essential fish habitat, wildlife, and endangered species), socioeconomic

environment (demographics, recreational use, and cultural resources) and the potential for cumulative impacts.

The preferred restoration project included in this DARP/EA (Table 4.1) will enhance the functionality of the ecosystem in the area impacted by the Spill and within the Galveston Bay system. None of the proposed projects in this DARP/EA have highly uncertain impacts or risks or are likely to violate any environmental protection laws. Further, the Trustees do not believe any of the proposed projects will adversely affect the quality of the human environment or pose any significant adverse environmental impacts. Instead, habitat protection and restoration will result in environmental benefits and improve the quality of the environment for local residents and recreational users.

The Trustees' analysis of environmental impacts associated with the no action alternative and the Gordy Marsh Living Shoreline project is provided below. This DARP/EA incorporates by reference the NEPA evaluation for the Swan Lake Marsh Restoration Project contained in Section 8 of the *Final Damage Assessment and Restoration Plan/Environmental Assessment for Malone Service Company Superfund Site, Galveston County, Texas City, Texas* (Malone Service Company Superfund Site Natural Resource Trustee Council 2015) and Section 5 of the *Final Supplement to the Final Damage Assessment and Restoration Plan and Environmental Assessment for the Malone Service Company Superfund Site, Texas City, Galveston County, Texas* (Malone Service Company Superfund Site Natural Resource Trustee Council 2022). In summary, the Swan Lake Marsh Restoration Project could be expected to have short-term, minor adverse impacts on, and to provide long-term benefits to, physical, biological, and socioeconomic resources. This DARP/EA also incorporates by reference the NEPA evaluation for the Landscape Scale Oyster Restoration Project contained in Section 4.3.3 of the *Deepwater Horizon Oil Spill Texas Trustee Implementation Group Final Restoration Plan/Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitat; Nutrient Reduction; Oysters; Sea Turtles; and Birds* (DWH TX TIG 2022). In summary, the Landscape Scale Oyster Restoration Project could be expected to have short-term, minor adverse impacts on, and to provide long-term benefits to, physical, biological, and socioeconomic resources.

5.1 Physical Environment

5.1.1 Air and Noise Pollution

No Action Alternative: There would be no adverse impacts to air quality and no noise above the ambient levels because there would be no construction activities associated with the no action alternative.

Gordy Marsh Living Shoreline: Short-term minor adverse impacts to air quality may occur during construction. Exhaust emissions (including greenhouse gasses) from heavy equipment contain air pollutants but these emissions would only occur during the construction phase, the amounts would be small, and should be quickly dissipated by prevailing winds. There would be no long-term adverse impacts to air quality.

Short-term minor adverse impacts associated with noise may occur during construction. The noise may periodically and temporarily disturb wildlife in the immediate vicinity of the site, or cause movement of wildlife away from the site to other ecologically suitable areas in the Galveston Bay system. Similarly, recreating humans may avoid nearby areas due to noise during construction, but as with air pollution, such disruption will be limited to the construction phase, and there are many comparable substitute recreation sites readily available within the general area. There would be no long-term adverse impacts due to noise.

5.1.2 Water Quality

No Action Alternative: There would be no adverse impacts to water quality associated with the no action alternative. However, there would also be no beneficial impacts from restoration of salt marsh which benefits water quality via nutrient cycling and sediment capture. Therefore, long-term benefits to water quality would not occur.

Gordy Marsh Living Shoreline: Short-term minor adverse impacts and long-term beneficial impacts are expected. Earth moving activities (i.e. placement of breakwater material) could result in an increase to local turbidity during construction. Increased suspended sediments can affect benthic filter feeders and young fish by damaging gills and feeding tissues. However, the tidal bay ecosystem is adapted to relatively high levels of suspended sediments, and best management practices (e.g. containment berms, erosion control, etc.) would be employed to minimize the extent, duration, and intensity of water quality impacts during construction. After construction is completed, the sediments should stabilize. Over the longer term, the preferred restoration project will re-establish, enhance, and increase estuarine marsh at the Site and help improve local water quality due to increased filtering capacity. Overall, the Trustees anticipate that any adverse impacts to water quality would be minor and short-term with long-term beneficial impacts.

5.2 Biological Environment

5.2.1 Vegetation

No Action Alternative: There would be no adverse impacts to vegetation associated with the no action alternative. However, there would also be no beneficial impacts from improved habitat.

Gordy Marsh Living Shoreline: Long-term beneficial impacts to vegetation are expected. This project would protect existing marsh and uplands and create new marsh habitat. Existing vegetation would be protected from erosion and new emergent vegetation would be planted behind the installed breakwater structure to expand the existing marsh. Since activities are occurring in open water and SAV is not expected to be present, no adverse impacts to vegetation are anticipated. Overall, the trustees anticipate long-term beneficial impacts to vegetation.

5.2.2 Aquatic Habitat

No Action Alternative: There would be no adverse impact to aquatic habitat associated with the no action alternative. However, there would also be no beneficial impacts from improved habitat.

Gordy Marsh Living Shoreline: Short-term, minor adverse impacts and long-term beneficial impacts to aquatic habitat are expected. This project would create and protect herbaceous wetlands. Direct, short-term, localized minor impacts would be expected on benthic fauna and infauna smothered by breakwater material placement. Behavior of species may be temporarily modified. These impacts may have the side effect of fish temporarily leaving their habitat in locations where there are construction activities to avoid being harmed. In most cases, fish return to restoration sites almost immediately or within a short time after construction (Bilkovik and Mitchell 2013). There would also be short- and long-term moderate impacts on substrates directly under the breakwater structure. However, the adverse impacts would be localized and long-term benefits would occur to the bottom substrates adjacent to the breakwaters due to stabilization of sediments and protection of the shoreline from erosion and wave action. Mitigation measures to minimize adverse impacts could include employment of standard best management practices for construction to reduce erosion and loss of sediments. Additionally, this project would result in long-term beneficial impacts by restoring or creating wetland and/or shallow-water habitats that provide areas for feeding and shelter for fish, as well as nutrient cycling and carbon sequestration and storage capacity. Emergent vegetation would form marsh. The functional value of herbaceous wetlands (i.e. marsh) is well documented in the scientific literature to have a positive effect on aquatic habitat, improving the estuarine food web. Overall, the Trustees anticipate that any adverse impacts to aquatic habitat would be minor and short to long-term with long-term beneficial impacts.

5.2.3 Fisheries and Essential Fish Habitat

No Action Alternative: There would be long-term, indirect, minor to moderate impacts to fisheries and EFH associated with the no action alternative. If the breakwater is not built, the current marsh habitat is expected to erode at a rate of 1-2 meters per year (Caudle and Paine 2024). Estuarine marsh is categorized as EFH for several federally managed fisheries species and erosion of the marsh would remove their critical nursery and feeding habitat.

Gordy Marsh Living Shoreline: There will be no adverse impacts and long-term beneficial impacts to fisheries and EFH. This project would protect and create EFH in the form of marsh habitat. Breakwaters will be placed on open water bottoms. Estuarine marsh is a category of EFH for several federally managed fishery species (e.g., white shrimp and red drum) and the preferred project would benefit EFH for such species. As a result, there would be no adverse impacts and long-term beneficial impacts.

5.2.4 Wildlife

No Action Alternative: There would be no adverse impacts to wildlife associated with the no action alternative. However, there would also be no beneficial impacts from improved habitat.

Gordy Marsh Living Shoreline: Short-term, minor adverse impacts and long-term beneficial impacts to wildlife are expected. Machinery and equipment used during construction of the preferred project could temporarily disturb wildlife near the construction activity. Adverse impacts on mobile species (e.g., birds, mammals) are expected to be minor, consisting of short-term displacement. Habitat improvements are expected to provide long-term beneficial impacts

to wildlife through enhancement and protection of their habitat. Overall, the Trustees anticipate that there would be short-term, minor adverse impacts with long-term beneficial impacts.

5.2.5 Endangered Species

No Action Alternative: There would be no adverse impacts to species listed as threatened or endangered under the Endangered Species Act (16 U.S.C. 1531 et seq.) associated with the no action alternative. However, there would also be no beneficial impacts from improved habitat.

Gordy Marsh Living Shoreline: No adverse impacts to threatened or endangered species or their critical designated habitats are anticipated. As noted in Section 2.2.4, several federal and state-listed species may be present in the area. The Trustees will ensure the preferred restoration project is implemented in compliance with the ESA via the United States Army Corps of Engineering permitting process and best management practices will be used, as appropriate. For example, construction will be done from the water with no upland staging that could impact bird nesting, no dredging is necessary to access the site, and fish passages will be installed roughly every 500ft. There would be long-term benefits since some listed species, such as piping plover and black rail, would benefit. As a result, there would be no adverse impacts and long-term beneficial impacts.

5.3 Socioeconomic Environment

5.3.1 Demographics

No Action Alternative: There would be no adverse impacts on populations in the area, including economically, socially, or in terms of conditions affecting their health. However, there would also be no beneficial impacts to the public from improved habitat and recreational opportunities.

Gordy Marsh Living Shoreline: This restoration project would have no adverse impacts on populations in the area, including economically, socially, or in terms of conditions affecting their health.

5.3.2 Recreational Use

No Action Alternative: There would be no adverse impacts to recreation associated with the no action alternative. However, there would also be no beneficial impacts.

Gordy Marsh Living Shoreline: Short-term, minor adverse impacts and long-term beneficial impacts to recreation are expected. The preferred project would cause some noise and increased turbidity during earth-moving activities. These construction activities likely decrease recreational enjoyment such as boating, fishing, and bird watching in the vicinity of the site. Any such effect will be limited to the period of construction and should be minor, as there are many comparable substitute recreation sites readily available nearby within the Galveston Bay system. Long-term benefits for recreational uses are likely due to improved aesthetics and expected increases in fish and bird populations following the construction of additional marsh habitat will add enjoyment for fisherman and bird watchers. Overall, the Trustees anticipate that there would be short-term, minor adverse impacts with long-term beneficial impacts.

5.3.3 Cultural Resources

No Action Alternative: There would be no adverse impacts to cultural resources associated with the no action alternative. Any potentially present cultural and historic resources would remain as they currently stand.

Gordy Marsh Living Shoreline: This restoration project would have no adverse impacts to significant cultural, scientific, or historic resources. A complete review of the restoration project location, to satisfy the requirements of Section 106 of the NHPA, would be completed prior to any activities that would restrict consideration of measures to avoid, minimize, or mitigate any adverse effects on historic properties located in the restoration area. The project would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

5.4 Impacts when Combined with Past, Present, and Reasonably Foreseeable Future Actions (Cumulative Impacts)

As part of the analysis of reasonably foreseeable effects of the proposed projects, the federal Trustees also considered the cumulative effects of their proposed projects within the affected environment. Cumulative impacts are the collective result of the incremental impacts of a project that, when added to the impacts of other past, present, and reasonably foreseeable future projects, would affect the same resources, regardless of what agency or person undertakes those projects. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Although the impacts of individual projects taken separately might be minor, the impact of those same projects taken together may be significant for one or multiple resources.

A cumulative impacts analysis focuses on the resources rather than the planned project and considers impacts that take place on both spatial and temporal scales. On a spatial basis, impacts must be considered both within and outside the restoration project area. Time scales for a cumulative impacts analysis are generally longer than project-specific analysis of impacts. The Trustees have reviewed potential past, present, and reasonably foreseeable projects to assess the potential for cumulative impacts.

No Action Alternative: The No Action Alternative is expected to result in cumulative, negative impacts and would not provide the conditions necessary for recovery. With No Action, key natural resources and services might not ever return to baseline. If the project is not implemented an opportunity would be lost to compensate the public for water column injuries.

Gordy Marsh Living Shoreline Project**:** The restoration at Gordy Marsh is expected to result in cumulative, beneficial impacts by reversing the trend of conversion of estuarine marsh to open water within the Galveston Bay system. This project is expected to have local impacts by protecting the area from erosion and storm surge. Additionally, the project is expected to provide regional impacts from improved water quality and by creating spawning habitat for estuarine fish and invertebrate species which may contribute to an improved fishery. The creation and enhancement of wildlife habitat supplements existing habitat in the region, increasing the

resiliency of bird and mammal populations that utilize the network of wetlands and wildlife corridors of the greater ecosystem. A net cumulative beneficial impact will likely result from the synergy with previous, current, and future restoration activities.

The Trustees also considered potential impacts associated with the construction of the preferred project. Given that areas around the Spill location are industrialized, there is a potential that commercial construction, or other industrial actions, could have impacts that are cumulative with those from the Project. Increased vessel traffic, increased turbidity from in-water activities, and other project-related impacts described above all have the potential to accumulate with other similar construction or industrial activities in the area. However, any such impacts from the restoration activities are expected to be short-term, and all are expected to be minor. Accordingly, the Trustees anticipate that any cumulative impacts will be similarly minor and short-term. Overall, the Trustees anticipate no adverse impacts and long-term beneficial impacts.

5.5 Conclusion

The Gordy Marsh Living Shoreline Project selected in this DARP/EA is considered in light of multiple planning efforts and opportunities in the region. This project builds upon prior and anticipated conservation activities implemented by the Texas natural resource agencies (TPWD, TCEQ, and GLO) and partnerships and organizations such as the Galveston Bay Foundation. Further, the project selected is intended to compensate the public (i.e., make the public and the environment whole) for resource injuries caused by the release of oil into the watershed. Overall, there are likely to be no significant adverse impacts from the Gordy Marsh Living Shoreline Project. A net cumulative beneficial impact may result from the synergy with previous and current restoration efforts, as well as future restoration activities.

The non-preferred projects analyzed in this DARP/EA include the Swan Lake Marsh Restoration Project and the Landscape Scale Oyster Restoration Project. Both were analyzed in detail in the documents incorporated by reference above. If implemented, both could be expected to have short-term, minor adverse impacts and to provide long-term benefits to physical, biological, and socioeconomic resources.

5.6 Certification

5.6.1 Certification Related to Page Limits

As part of the finalization of this EA, the Federal Trustees certify that they have considered the factors mandated by NEPA; that the EA represents the Trustees' good-faith effort to prioritize documentation of the most important considerations required by the statute within the congressionally mandated page limits that this prioritization reflects the Trustees' expert judgment; and that any considerations addressed briefly or left unaddressed were, in the Trustees' judgment, comparatively not of a substantive nature that meaningfully informed the consideration of environmental effects and the resulting decision on how to proceed.

5.6.2 Certification Related to Time Limits

As part of the finalization of this EA, the Federal Trustees certify that this EA represents the Trustees' good-faith effort to fulfill NEPA's requirements within the congressionally mandated timeline that such effort is substantially complete; that, in the Trustees' expert opinion, they have thoroughly considered the factors mandated by NEPA; and that, in the Trustees' judgment, the analysis contained therein is adequate to inform and reasonably explain the Trustees' final decision regarding the proposed activity or decision.

6 COMPLIANCE WITH OTHER AUTHORITIES

6.1 Federal Laws

Additional federal laws may apply to the preferred project considered in this DARP/EA. All federal, state and local laws will be complied with prior to project implementation. Federal laws, regulations, and EO that may be applicable include, but are not limited to, the following:

- Endangered Species Act (16 USC 1531 et seq.)
- Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 et seq.)
- Marine Mammal Protection Act (16 USC 1361 et seq.)
- Coastal Zone Management Act (16 USC 1451 et seq.)
- National Historic Preservation Act (16 USC 470 et seq.)
- Migratory Bird Treaty Act (16 USC 703 et seq.)
- Bald and Gold Eagle Protection Act (16 USC 668 et seq.)
- Clean Air Act (42 USC 7401 et seq.)
- Federal Water Pollution Control Act (Clean Water Act) (33 USC 1251 et seq.) and/or Rivers and Harbors Act (33 USC 401 et seq.)
- Marine Protection, Research and Sanctuaries Act (16 USC 1431 et seq. and 33 USC 1401 et seq.)
- Estuary Protection Act (16 USC 1221–1226)
- Archaeological Resource Protection Act (16 USC 470aa–470mm)
- National Marine Sanctuaries Act (16 USC 1431 et seq.)
- Farmland Protection Policy Act (7 USC 4201–4209)
- Rivers and Harbors Act (33 USC 401 et seq.)
- EO 11988: Floodplain Management (augmented by EO 13690, January 30, 2015)
- EO 11990: Protection of Wetlands
- EO 12962: Recreational Fisheries
- EO 13007: Indian Sacred Sites
- EO 13112: Safeguarding the Nation from the Impacts of Invasive Species
- EO 13175: Consultation and Coordination with Indian Tribal Governments
- EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds

6.2 State and Local Laws

The Trustees would ensure compliance with all applicable state and local laws relevant to the State of Texas. Applicable laws and regulations may include, but are not limited to, the following:

- Texas Natural Resources Code (TNRC)
- Coastal Public Lands Management Act (TNRC § 33.001 et seq.)
- Texas Parks and Wildlife Code
- Texas Water Code
- Texas Health and Safety Code

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