Deepwater Horizon Oil Spill Natural Resource Damage Assessment

Texas Trustee Implementation Group Draft Restoration Plan/Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds

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EXECUTIVE SUMMARY

On April 20, 2010, the Deepwater Horizon (DWH) mobile drilling unit exploded, caught fire, and eventually sank in the Gulf of Mexico, resulting in a massive release of oil and other substances from BP Exploration and Production's (BP's) Macondo well and causing loss of life and extensive natural resources injuries. Initial efforts to cap the well following the explosion were unsuccessful, and for 87 days after the explosion, the well continuously and uncontrollably discharged oil and natural gas into the northern Gulf of Mexico. Approximately 3.19 million barrels (134 million gallons) of oil was released into the ocean (US DOJ 2016). Oil spread from the deep ocean to the ocean surface and nearshore environment from Texas to Florida. Extensive response actions, including cleanup activities and actions to try to prevent the oil from reaching sensitive resources, were undertaken to try to reduce harm to people and the environment. However, many of the response actions had collateral impacts on the environment and on natural resource services.

As part of a 2016 settlement, BP agreed to pay a total of $8.1 billion in natural resource damages (inclusive of Early Restoration funding[1]) over a 15-year period, and up to an additional $700 million for adaptive management or to address natural resources injuries that are presently unknown but may become apparent in the future. The settlement allocated a specific sum for restoration within specific Restoration Areas and across restoration types (described in more detail below).

The Texas Trustee Implementation Group (Texas TIG) is responsible for restoring natural resources and their services that were injured by the DWH oil spill within the Texas Restoration Area. The purpose of restoration, as discussed in the *Deepwater Horizon Oil Spill Texas Trustee Implementation Group Draft Restoration Plan/Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds* (RP/EA #2) and in more detail in the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH Trustees 2016a), is to make the environment and the public whole for injuries resulting from the spill. This will be achieved by implementing restoration actions that return injured natural resources and services to baseline conditions and compensate for interim losses in accordance with the Oil Pollution Act of 1990 (OPA) and associated natural resource damage assessment (NRDA) regulations. The Final PDARP/PEIS and record of decision are available at www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/.

The Texas TIG prepared the RP/EA #2 to address injuries to natural resources in the Texas Restoration Area resulting from the spill. In the Final PDARP/PEIS, the DWH Trustees adopted a portfolio of 13 restoration types that address the diverse suite of injuries that occurred at both regional and local scales (DWH Trustees 2016a). The RP/EA #2 is focused on five restoration types: Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Sea Turtles; Birds; and Oysters.

The purpose of the RP/EA #2 is to 1) inform the public about DWH NRDA restoration planning efforts, 2) analyze projects that address specific restoration types, and 3) seek public comment on proposed restoration projects.

[1] BP agreed to provide up to $1 billion toward Early Restoration projects in the Gulf of Mexico to address injuries to natural resources caused by the DWH oil spill in the Early Restoration Framework Agreement. Early Restoration proceeded in phases, with each phase adding additional projects to partially address injuries to nearshore resources, birds, fish, sea turtles, federally managed lands, and recreational uses. Sixty-five projects with a total cost of approximately $877 million were selected through the five phases of Early Restoration planning.

The project alternative screening process developed by the Texas TIG for the purpose of preparing the RP/EA #2 was initiated via issuance of a notice of solicitation to the public on October 1, 2020, to request submission of project ideas. The Texas TIG screened project ideas through a four-step process, described in Section 2 of the RP/EA #2. This process resulted in a reasonable range of alternatives in the RP/EA #2 that were evaluated under OPA NRDA regulatory criteria (15 CFR Section 990.54) and the National Environmental Policy Act (NEPA). A summary of the reasonable range of alternatives evaluated in the RP/EA #2 is provided in Table ES-1.

Table ES-1. The Reasonable Range of Restoration Alternatives Proposed in the RP/EA #2 by Restoration Type

Reasonable Range of Restoration Alternatives	Preferred/Not Preferred	Preferred Alternative Cost	Not Preferred Alternative Cost
Wetlands, Coastal, and Nearshore Habitat Alternatives			
Bird Island Cove Habitat Restoration - Construction	Preferred	$5,000,000	
Bahia Grande Channel F Hydrologic Restoration	Preferred	$1,500,000	
Follets Island Habitat Acquisition Phase 2	Preferred	$3,300,000	
Galveston Island Habitat Acquisition	Preferred	$1,120,000	
Matagorda Peninsula Habitat Acquisition	Not preferred		$1,300,000
Nutrient Reduction (Nonpoint Source) Alternatives			
Petronila Creek Constructed Wetlands Planning (engineering and design only)	Preferred	$450,000	
Petronila Creek Watershed Nutrient Reduction Initiative	Preferred	$4,300,000	
Petronila Creek Crooked Ditch Restoration	Not preferred		$6,500,000
Oyster Alternatives			
Landscape Scale Oyster Restoration in Galveston Bay	Preferred	$9,500,000	
St. Charles Bay Oyster Reef Restoration	Not preferred		$2,500,000
Sea Turtle Alternatives			
Upper Texas Coast Sea Turtle Rehabilitation Facility	Preferred	$2,500,000	
Lancha Sea Turtle Mitigation Plan	Preferred	$2,220,000	
Kemp's Ridley Sea Turtle Nest Protection	Not preferred		$2,200,000
Bird Alternatives			
Laguna Vista Rookery Island Habitat Protection	Preferred	$2,100,000	
Jones Bay Oystercatcher Habitat Restoration	Preferred	$2,300,000	
San Antonio Bay Bird Island	Preferred	$1,500,000	
Texas Breeding Shorebird and Seabird Stewardship	Preferred	$3,400,000	
Gulf Cut Bird Islands Restoration	Not preferred		$13,000,000
Total Proposed		**$39,190,000**	**$25,500,000**

The Texas TIG includes three Texas State Trustee agencies and four federal Trustee agencies: Texas Commission on Environmental Quality; Texas Parks and Wildlife Department; Texas General Land Office; National Oceanic and Atmospheric Administration, on behalf of the U.S. Department of Commerce; U.S. Department of the Interior, represented by the U.S. Fish and Wildlife Service, National Park Service, and Bureau of Land Management; U.S. Department of Agriculture; and U.S. Environmental Protection Agency.

The U.S. Environmental Protection Agency is the lead federal Trustee for preparing the RP/EA #2 pursuant to NEPA and its own NEPA implementing procedures. The other federal and state agencies of the Texas TIG are acting as cooperating agencies for the purposes of compliance with NEPA in the development of this document (40 CFR Section 1501.8 and 1508.1(e)). Each will review the final document for adequacy in meeting the standards set forth in agency-specific NEPA implementing procedures. Each federal agency will then decide whether to adopt the analysis to inform its own decision-making and fulfill its responsibilities under NEPA. Adoption of the RP/EA #2 by the federal cooperating agencies would require signature on the relevant NEPA decision document.

The public is encouraged to review and comment on the RP/EA #2 during the 30-day comment period following the public notice of availability. Comments can be submitted during the comment period by one of the following methods:

Online: https://parkplanning.nps.gov/TXRP2

By mail (hard copy), addressed to the following:
U.S. Fish and Wildlife Service
P.O. Box 29649
Atlanta, Georgia 30345

To be considered, mailed comments must be postmarked on or before the comment deadline specified in the *Federal Register* and at https://www.gulfspillrestoration.noaa.gov/restoration-areas/texas.

Public webinar: The Texas TIG will hold a webinar to facilitate the public review and comment process. The webinar will take place on March 9, 2022, at 6 p.m. Central Standard Time. It can be accessed via the following link: https://attendee.gotowebinar.com/register/2667653123715836432.

After the comment period closes, the Texas TIG will consider all timely public comments and revise the RP/EA #2, as appropriate. A summary of comments and the Texas TIG's responses, where applicable, will be included in the final RP/EA #2. Ultimately, public comments on the document are intended to guide the Texas TIG's selection of alternatives for implementation that best meet its purpose and need, as summarized above and described in more detail in subsequent sections of this document.

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ABBREVIATIONS

°C	degrees Celsius
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BMP	best management practice
BP	BP Exploration and Production, Inc.
CAA	Clean Air Act
CBBEP	Coastal Bend Bays and Estuaries Program
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMA	Coastal Management Area
CP	conservation practices
CWA	Clean Water Act
DOI	U.S. Department of the Interior
DWH	Deepwater Horizon
E&D	Engineering and design
EFH	essential fish habitat
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
Final PDARP/PEIS	*Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement*
FONSI	finding of no significant impact
GCBO	Gulf Coast Bird Observatory
GEBF	Gulf Environmental Benefit Fund
GHGs	greenhouse gases
GIWW	Gulf Intracoastal Waterway
HTRW	hazardous, toxic, and radioactive waste
HUC	hydrologic unit codes
LF	linear feet
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MAM	monitoring and adaptive management
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act

NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NFWF	National Fish and Wildlife Foundation
NHRP	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	notice of solicitation
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRDA	natural resource damage assessment
NRHP	National Register of Historic Places
OPA	Oil Pollution Act
PAIS	Padre Island National Seashore
RESTORE Act	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
RMC	Resource Management Code
ROD	Record of Decision
RP/EA #2	*Deepwater Horizon Oil Spill Texas Trustee Implementation Group Restoration Plan/Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*
RRC	Railroad Commission of Texas
RW RP/EA #1	*Regionwide Trustee Implementation Group Final Restoration Plan/ Environmental Assessment 1: Birds, Marine Mammals, Oysters, and Sea Turtles*
RW TIG	Regionwide Trustee Implementation Group
SHPO	State Historic Preservation Officer
SIP	state implementation plan
SOI	Secretary of the Interior
STSSN	Sea Turtle Stranding and Salvage Network
SWPPP	stormwater pollution prevention plan
TAMUG	Texas A&M University at Galveston
TASA	Texas Archeological Sites Atlas
TCEQ	Texas Commission on Environmental Quality
TDS	total dissolved solids

TX TIG RP/EA #1	*Final 2017 Texas Restoration Plan/Environmental Assessment: Restoration of Wetlands, Coastal, and Nearshore Habitats; and Oysters*
Texas TIG	Texas Trustee Implementation Group
TGLO	Texas General Land Office
THC	Texas Historical Commission
TMDL	total maximum daily load
TNRC	Texas Natural Resources Code
TPWD	Texas Parks and Wildlife Department
Trustee Council SOP	*Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill*
TxDOT	Texas Department of Transportation
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
UTV	utility task vehicle
WMA	wildlife management area

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CHAPTER 1 INTRODUCTION, PURPOSE AND NEED, AND PUBLIC PARTICIPATION

This *Texas Trustee Implementation Group Draft Restoration Plan/Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds* (hereafter referred to as *RP/EA #2* or *document*) was prepared by the Texas Trustee Implementation Group (Texas TIG) to initiate planning and restoration of natural resources and services they provide in the Texas Restoration Area that were injured by the Deepwater Horizon (DWH) oil spill. The purpose of restoration, as discussed in this document and detailed more fully in the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH Trustees 2016a), is to make the environment and the public whole for injuries resulting from the spill by implementing restoration actions that return injured natural resources and services to baseline conditions and compensate for interim losses in accordance with the Oil Pollution Act of 1990 (OPA) and associated NRDA regulations. The Final PDARP/PEIS and record of decision (ROD) can be found online at http: //www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/.

The Texas TIG includes three Texas State Trustee agencies and four federal Trustee agencies: Texas Commission on Environmental Quality (TCEQ); Texas Parks and Wildlife Department (TPWD); Texas General Land Office (TGLO); National Oceanic and Atmospheric Administration (NOAA), on behalf of the U.S. Department of Commerce; U.S. Department of the Interior (DOI), represented by the U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS), and Bureau of Land Management (BLM); U.S. Department of Agriculture (USDA); and U.S. Environmental Protection Agency (EPA) (collectively, the Texas TIG).

The RP/EA #2 evaluates a reasonable range of alternatives to restore wetlands, coastal and nearshore habitats; nutrient reduction; oysters; sea turtles; and birds in the Texas Restoration Area. In this document, the Texas TIG identifies its preferred alternatives to partially compensate the public for injuries caused by the spill.

1.1 Background and Summary of the Settlement

In response to the April 20, 2010, DWH oil spill, the DWH Trustees issued the February 2016 Final PDARP/PEIS detailing a specific proposed plan to fund and implement restoration projects across the Gulf of Mexico region into the future as restoration funds become available. The Final PDARP/PEIS describes restoration types, approaches, and techniques that meet the Trustees' programmatic restoration goals (DWH Trustees 2016a). On March 29, 2016, in accordance with OPA and NEPA, the DWH Trustees issued a notice of availability of a ROD for the Final PDARP/PEIS in the *Federal Register* (81 FR 17438; DWH Trustees 2016b).

On April 4, 2016, the U.S. District Court for the Eastern District of Louisiana entered a Consent Decree resolving civil claims by the DWH Trustees against BP Exploration and Production, Inc. (BP) arising from the spill. The Final PDARP/PEIS (DWH Trustees 2016a) sets forth the process for DWH restoration planning to select specific projects for implementation and establishes a distributed governance structure that assigns a TIG for each Restoration Area. Each Restoration Area has a specific monetary allocation to each restoration type specified in the Consent Decree. The DWH settlement allocation for the Texas TIG by restoration type is described in Section 5.10.2 of the Final PDARP/PEIS and provided below in Table 1-1. Table 1-1 also shows funds allocated for Early Restoration, funds allocated in TX TIG RP/EA #1, and funds proposed for allocation in the RP/EA #2. More details on the background of the spill, the impact of the spill on the Gulf of Mexico ecosystem, and additional context for the settlement and allocation of funds can be found in Chapter 2 of the Final PDARP/PEIS (DWH Trustees 2016a).

Table 1-1. Allocation of Deepwater Horizon Settlement Funds for the Texas Restoration Area by Restoration Type

Restoration Goal	Restoration Type	Total Texas Settlement Funds	Allocated During Early Restoration	Funds Allocated in TX TIG RP/EA #1	Funds Proposed in the RP/EA #2
Restore and conserve habitat	Wetlands, Coastal, and Nearshore Habitat	$100,000,000	$0	$45,452,000	$10,920,000
Restore water quality	Nutrient Reduction (Nonpoint Source)	$22,500,000	$0	$0	$4,750,000
Replenish and protect living coastal and marine resources	Sea Turtles	$27,465,000	$19,965,000	$0	$4,720,000
	Birds	$40,603,770	$20,603,770	$0	$9,300,000
	Oysters	$22,500,000	$0	$309,000	$9,500,000
Provide and enhance recreational opportunities	Provide and Enhance Recreational Opportunities	$18,582,688	$18,582,688	$0	$0
Monitoring, adaptive management, and administrative oversight to support restoration implementation		$6,500,000	$0	$0	$0
Total NRDA funding for Texas		**$238,151,458**	**$59,151,458**	**$ 45,761,000**	**$39,190,000**

1.2 Deepwater Horizon Trustees and Trustee Council

The DWH Trustees are the entities authorized under OPA to act as trustees on behalf of the public to assess the natural resource injuries resulting from the DWH oil spill and to develop and implement project-specific restoration plans to compensate for those injuries. The DWH Trustees fulfill these responsibilities by developing restoration plans, providing the public with a meaningful opportunity to submit restoration projects and to review and comment on proposed plans, implementing and monitoring restoration projects and activities, managing natural resource damage funds, and documenting trustee decisions through a public administrative record. The DWH Trustees are responsible for governance of restoration planning throughout the entire Gulf Coast.

As required under OPA, the DWH Trustees conducted a NRDA (see Section 3 for details on the NRDA process). As part of this effort, the DWH Trustees organized a Trustee Council composed of Designated Natural Resource Trustee Officials, or their alternates, for each of the DWH Trustee agencies. The following federal and state agencies are the designated DWH Trustees under OPA for the spill:

- The Federal Government’s NOAA, on behalf of the U.S. Department of Commerce, DOI, as represented by the NPS, USFWS, and BLM, EPA, and USDA;
- The State of Alabama’s Department of Conservation and Natural Resources and Geological Survey of Alabama;
- The State of Florida’s Department of Environmental Protection and Fish and Wildlife Conservation Commission;
- The State of Louisiana’s Coastal Protection and Restoration Authority, Louisiana Oil Spill Coordinator’s Office, Louisiana Department of Environmental Quality, Louisiana Department of Wildlife and Fisheries, and Louisiana Department of Natural Resources;
- The State of Mississippi’s Department of Environmental Quality; and
- The State of Texas’ TPWD, TGLO, and TCEQ.

The DWH NRDA funds provided under the Consent Decree were distributed geographically to address the diverse suite of injuries that occurred at both regional and local scales. As specified in the Consent Decree (US DOJ 2016) and Final PDARP/PEIS, specific amounts of money were allocated to seven geographic areas: each of the five Gulf States (Texas, Louisiana, Mississippi, Alabama, and Florida), regionwide, and the open ocean. The funding distribution was based on the DWH Trustees’ understanding and evaluation of exposure and injury to natural resources and services, as well as their evaluation of where restoration spending for the various restoration types would be most beneficial within the ecosystem-level restoration portfolio (DWH Trustees 2016a).

1.3 Authorities and Regulations

1.3.1 Oil Pollution Act and National Environmental Policy Act Compliance

As an oil pollution incident, the DWH oil spill is subject to the provisions of OPA (33 United States Code [USC] Section 2701 et seq.). A primary goal of OPA is to make the environment and public whole for injuries to natural resources and services resulting from an incident involving an oil discharge or substantial threat of an oil discharge. Under 15 Code of Federal Regulations (CFR) Section 990.54-55 the Trustees consider a reasonable number of restoration alternatives, including a no-action alternative, and consider relevant factors when selecting a restoration project.

Federal trustees must comply with NEPA, 42 USC Section 4321 et seq. and its regulations, 40 CFR Section 1500-1508 and other applicable statutes and regulations when planning restoration projects. NEPA requires federal agencies to consider the potential environmental impacts of their proposed actions. NEPA provides a framework for federal agencies to determine if their proposed actions may have significant environmental, social and economic effects, to consider these effects when choosing between alternatives, and to inform and involve the public in the environmental analysis and decision-making process.

In the RP/EA #2, the Texas TIG addresses NEPA requirements by using the environmental analyses conducted in the Final PDARP/PEIS, evaluating and refining existing analyses, and preparing environmental consequences analyses for alternatives considered in this document, as appropriate. See Chapter 6 of the Final PDARP/PEIS (DWH Trustees 2016a) for more information on tiering and incorporation by reference under NEPA, and how these processes apply to this document.

Pursuant to NEPA, a no action alternative is included in the RP/EA #2 analysis as a "… benchmark, enabling decision makers to compare the magnitude of environmental effects of the action alternatives." Therefore, a no action alternative for each restoration type is evaluated within the EA portion of this document. The no action analysis presents the conditions that would result if none of the restoration alternatives proposed in this document were implemented. The environmental consequences of such an alternative are evaluated in Section 4 for comparison with the remaining alternatives.

The EPA is the lead federal Trustee for preparing the RP/EA #2 pursuant to NEPA (40 CFR Section 1501.7). The other federal and state agencies of the Texas TIG are acting as cooperating agencies for the purposes of compliance with NEPA in the development of this document (40 CFR Section 1501.8 and 1508.1(e)). Each will review the final document for adequacy in meeting the standards set forth in agency-specific NEPA implementing procedures. Each federal agency will then decide whether to adopt the analysis to inform its own decision-making and fulfill its responsibilities under NEPA. Adoption of the RP/EA #2 by the federal cooperating agencies would require signature on the relevant NEPA decision document.

The RP/EA #2 includes a preliminary finding of no significant impact (FONSI) in Section 5.1. EPA's NEPA implementing procedures at 40 CFR Section 6.203(b)(1) state that "[a]t least thirty (30) calendar days before making the decision on whether, and if so how, to proceed with a proposed action, the Responsible Official must make the EA and preliminary FONSI available for review and comment to the interested federal agencies, state and local governments, federally recognized Indian tribes and the affected public. The Responsible Official must respond to any substantive comments received and finalize the EA and FONSI before making a decision on the proposed action." The required thirty-day public comment period commences upon publication of the Notice of Availability of the RP/EA #2 in the *Federal Register*.

1.3.2 Trustee Council Standard Operating Procedures

Another document that guides restoration planning is the *Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the Deepwater Horizon (DWH) Oil Spill* (Trustee Council SOP August 2021). The Trustee Council developed and approved by consensus these standard operating procedures for administration, implementation, and long-term management of restoration under the Final PDARP/PEIS (DWH Trustees 2016a) which provides common procedures to be used by all TIGs. The Trustee Council SOP addresses, among other issues, decision-making and delegation of authority, funding, administrative procedures, project reporting, monitoring and adaptive management (MAM), consultation opportunities among the DWH Trustees, public participation, and the administrative record. The Trustee Council SOP may be amended as needed. The division of responsibilities among the Trustee Council, TIGs, and individual trustee agencies is summarized in Table 7.2-1 of the Final PDARP/PEIS (DWH Trustees 2016a).

1.3.3 Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement and Record of Decision

As a programmatic restoration plan, the Final PDARP/PEIS provides direction and guidance for identifying, evaluating, and selecting future restoration projects to be carried out by the TIGs (see Section 5.10.4 and Chapter 7 of the Final PDARP/PEIS [DWH Trustees 2016a]). The DWH Trustees elected to prepare a PEIS to support analysis of the environmental consequences of the selected restoration types, to consider the many related actions that may occur because of restoration planning efforts, and to allow for a better analysis of cumulative impacts of potential actions. The programmatic approach was taken to assist the TIGs in their development and evaluation and to assist the public in its review of future restoration projects. The Final PDARP/PEIS was also developed to support a tiered analysis and decision making with the anticipation that certain future restoration actions could be undertaken without additional NEPA review, whereas others might proceed based on more focused tiered EAs or EISs.

For the Final PDARP/PEIS, the DWH Trustees developed a set of restoration types for inclusion in programmatic alternatives, consistent with the desire to seek a diverse set of projects providing benefits to a broad array of injured natural resources and services. Ultimately, this process resulted in the inclusion of five programmatic restoration goals: 1) restore and conserve habitat; 2) restore water quality; 3) replenish and protect living coastal and marine resources; 4) provide and enhance recreational opportunities; and 5) provide for monitoring, adaptive management, and administrative oversight to support restoration implementation (DWH Trustees 2016a). The 13 restoration types under these goals are:

1. Wetlands, Coastal, and Nearshore Habitats;
2. Habitat Projects on Federally Managed Lands;
3. Nutrient Reduction (Nonpoint Source);
4. Water Quality (e.g., Stormwater Treatments, Hydrologic Restoration, Reduction of Sedimentation, etc.);
5. Fish and Water Column Invertebrates;
6. Sturgeon;
7. Submerged Aquatic Vegetation;
8. Oysters;
9. Sea Turtles;
10. Marine Mammals;
11. Birds;
12. Mesophotic and Deep Benthic Communities; and
13. Provide and Enhance Recreational Opportunities.

The RP/EA #2 is consistent with the Final PDARP/PEIS and ROD (DWH Trustees 2016a, 2016b), tiering the NEPA analysis from the Final PDARP/PEIS where applicable. For this document, the DWH Trustees considered the extent to which additional NEPA analyses may be necessary for the alternatives. These considerations include whether the analyses of relevant conditions and environmental effects described in the Final PDARP/PEIS are still valid and whether impacts under the alternatives have already been fully analyzed in the Final PDARP/PEIS. The applicable sections of the Final PDARP/PEIS are incorporated by reference into this plan.

Section 2 of the RP/EA #2 summarizes the screening process used to develop a reasonable range of alternatives, which is consistent with the DWH Trustees' selected programmatic alternative in the Final PDARP/PEIS, the Consent Decree, and OPA. The Texas TIG used the direction and the guidance of the Final PDARP/PEIS (DWH Trustees 2016a) to consider and evaluate alternatives within Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds restoration types.

1.3.4 Relationship of this Restoration Plan/Environmental Assessment #2 to the Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement

The reasonable range of alternatives included in the RP/EA #2 (Table 1-2) is consistent with the following restoration types: Wetlands, Coastal and Nearshore Habitats (DWH Trustees 2016a: Section 5.5.2); Nutrient Reduction (DWH Trustees 2016a: Section 5.5.4); Oysters (DWH Trustees 2016a: Section 5.5.9); Sea Turtles (DWH Trustees 2016a: Section 5.5.10); and Birds (DWH Trustees 2016a: Section 5.5.12).

To date, the Texas TIG has released one restoration plan to the public which includes an analysis of some of the alternatives considered in this document and is incorporated in the applicable sections:

- Final 2017 Texas Restoration Plan/Environmental Assessment: Restoration of Wetlands, Coastal, and Nearshore Habitats; and Oysters (TX TIG RP/EA #1) (Texas TIG 2017).

In addition, the DWH Trustees recently issued a final Regionwide TIG RP/EA that includes an analysis of some of the alternatives included in this document and is incorporated by reference in the applicable sections:

- Regionwide Trustee Implementation Group Final Restoration Plan/Environmental Assessment 1: Birds, Marine Mammals, Oysters, and Sea Turtles (RW RP/EA #1) (Regionwide Trustee Implementation Group [RW TIG] 2021).

1.4 Restoration Purpose and Need

The Texas TIG is undertaking this restoration planning effort for the purpose of restoring natural resources and the services they provide in the Texas Restoration Area. Restoration activities are needed to restore or replace habitats, species, and services to their baseline condition (primary restoration) and to compensate the public for interim losses from the time natural resources are injured until they recover to baseline conditions (compensatory restoration). The RP/EA #2 falls within the scope of the purpose and need identified in the Final PDARP/PEIS, which identified extensive and complex injuries to natural resources and their services across the Gulf, as well as a need and plan for comprehensive restoration consistent with OPA. As described in Section 5.3 of the Final PDARP/PEIS, the five programmatic restoration goals (see Table 1-1) work independently and together to benefit injured resources and services (DWH Trustees 2016a). The selected alternatives in this document address three of the five Trustee programmatic restoration goals: 1) restore and conserve habitat, 2) restore water quality, and 3) replenish and protect living coastal and marine resources.

Additional information about the purpose and need for DWH NRDA restoration can be found in Section 5.3.2 of the Final PDARP/PEIS (DWH Trustees 2016a).

1.5 Proposed Action

The Texas TIG proposes to undertake the planning and implementation of the 13 projects identified as preferred alternatives in the RP/EA #2 to support the goals described in the Final PDARP/PEIS. These alternatives would restore wetlands, coastal and nearshore habitat (four preferred alternatives); provide nutrient reduction benefits to the coastal environment and associated habitats (two preferred alternatives); restore oyster habitat (one preferred alternative); restore sea turtle habitat (two preferred alternatives); and restore lost bird habitat (four preferred alternatives) using funds made available through the DWH Consent Decree and Final PDARP/PEIS (DWH Trustees 2016a). Table 1-2 identifies these alternatives, along with the restoration type and associated costs. The Texas TIG proposes to use $39,190,000 of the Texas TIG NRDA funds. Alternatives considered for implementation in this plan are listed below and detailed in Sections 3 and 4. For the purposes of this document, each proposed project is considered a separate alternative. The terms *project* and *alternative* may be used interchangeably in this document.

Table 1-2. The Alternative Name, Restoration Type, and Associated Costs

Alternative	Preferred/Not Preferred	Preferred Alternative Cost	Not Preferred Alternative Cost
Wetlands, Coastal, and Nearshore Habitat Alternatives			
Bird Island Cove Habitat Restoration - Construction	Preferred	$5,000,000	
Bahia Grande Channel F Hydrologic Restoration	Preferred	$1,500,000	
Follets Island Habitat Acquisition Phase 2	Preferred	$3,300,000	
Galveston Island Habitat Acquisition	Preferred	$1,120,000	
Matagorda Peninsula Habitat Acquisition	Not preferred		$1,300,000
Nutrient Reduction (Nonpoint Source) Alternatives			
Petronila Creek Constructed Wetlands Planning (engineering and design [E&D] only)	Preferred	$450,000	
Petronila Creek Watershed Nutrient Reduction Initiative	Preferred	$4,300,000	
Petronila Creek Crooked Ditch Restoration	Not preferred		$6,500,000
Oyster Alternatives			
Landscape Scale Oyster Restoration in Galveston Bay	Preferred	$9,500,000	
St. Charles Bay Oyster Reef Restoration	Not preferred		$2,500,000
Sea Turtle Alternatives			
Upper Texas Coast Sea Turtle Rehabilitation Facility	Preferred	$2,500,000	
Lancha Sea Turtle Mitigation Plan	Preferred	$2,220,000	
Kemp’s Ridley Sea Turtle Nest Protection	Not preferred		$2,200,000
Bird Alternatives			
Laguna Vista Rookery Island Habitat Protection	Preferred	$2,100,000	
Jones Bay Oystercatcher Habitat Restoration	Preferred	$2,300,000	
San Antonio Bay Bird Island	Preferred	$1,500,000	
Texas Breeding Shorebird and Seabird Stewardship	Preferred	$3,400,000	
Gulf Cut Bird Islands Restoration	Not preferred		$13,000,000
Total Proposed		**$39,190,000**	**$25,500,000**

1.6 Alternatives Evaluated in this Plan

In total, the Texas TIG evaluated 18 action alternatives as the reasonable range of alternatives in the RP/EA #2. The Texas TIG also analyzed a No Action Alternative. These alternatives are intended to contribute to restoration of wetlands, coastal, and nearshore habitats; nutrient reduction; and restoration of oysters, sea turtles, and birds in the Texas Restoration Area. Table 1-2 identifies the alternatives evaluated through the process described in this document, including the 13 alternatives preferred for implementation. The locations of the alternatives are shown on Figure 1-1. The reasonable range of alternatives included in this document (see Table 1-2) is consistent with the following restoration types in the PDARP/PEIS: Wetlands, Coastal, and Nearshore Habitats (DWH Trustees 2016a: Section 5.5.2); Nutrient Reduction (DWH Trustees 2016a: Section 5.5.4); Oysters (DWH Trustees 2016a: Section 5.5.9); Sea Turtles (DWH Trustees 2016a: Section 5.5.10); and Birds (DWH Trustees 2016a: Section 5.5.12).

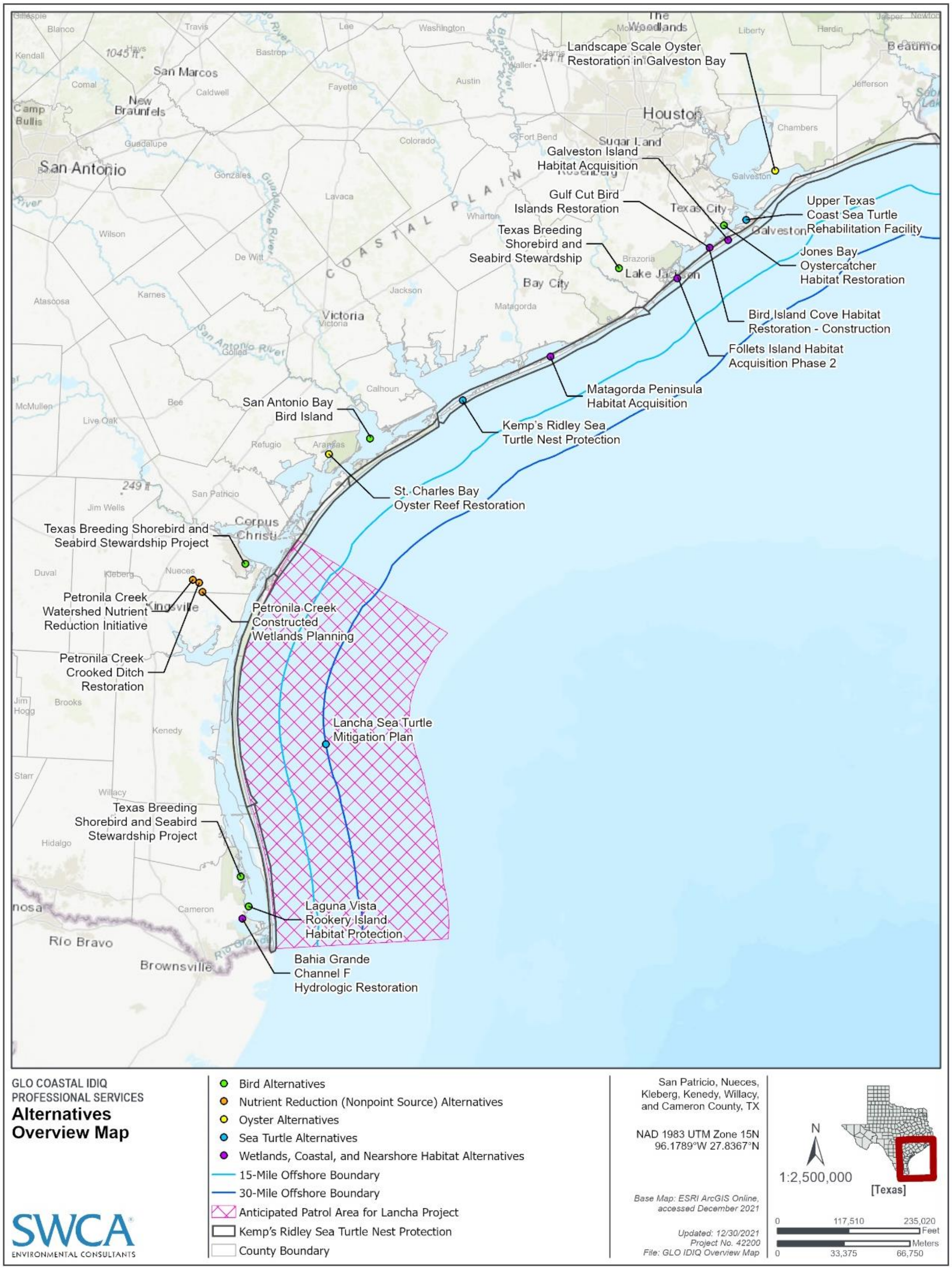

Figure 1-1. Location of the reasonable range of alternatives evaluated.

1.7 Severability of Projects

Restoration alternatives identified in the RP/EA #2 are independent of each other and may be selected independently by the Texas TIG. A decision not to select one or more of the alternatives does not affect the Texas TIG's selection of any remaining alternatives.

1.8 Coordination with Other Gulf Restoration Programs

As discussed in Section 1.5.6 of the Final PDARP/PEIS, the DWH Trustees are committed to coordination with other Gulf of Mexico restoration programs to maximize the overall ecosystem impact of DWH NRDA restoration efforts (DWH Trustees 2016a). In addition to NRDA-funded restoration, two other funding sources are specifically intended to address DWH restoration on the Gulf Coast: 1) the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) and 2) the National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit Fund (GEBF).

During the restoration planning process, the Texas TIG has coordinated and will continue to coordinate with other DWH oil spill restoration programs, including RESTORE Act, GEBF, and other state and federal funding sources. In so doing, the Texas TIG has reviewed the projects in other coastal restoration programs and is attempting to create synergies with those programs to ensure the most effective use of available funds for the maximum coastal benefit. This coordination ensures that funds are allocated for critical restoration projects across the affected regions and within appropriate coastal Texas areas. The Texas TIG will continue to collaborate with other restoration programs to maximize cost savings and restoration benefits to the resources in coastal Texas.

1.9 Public Participation

The Texas TIG issued a notice of solicitation (NOS) to the public on October 1, 2020, requesting the submission of project ideas to restore and conserve wetlands, coastal, and nearshore habitats; address nutrient reduction; and restore sea turtles, birds, and oysters. The project submission period closed on December 10, 2020 (Gulf Spill Restoration 2020). Project ideas were evaluated through a project screening process and a reasonable range of alternatives was developed by the Trustees. On August 23, 2021, the Texas TIG issued a notice of intent to conduct restoration planning, informing the public that it was drafting a restoration plan (Gulf Spill Restoration 2021).

1.9.1 Comment Period and Public Meeting

The public is encouraged to review and comment on the draft RP/EA #2. Following public notice, this document will be available to the public for a 30-day comment period. The deadline for submitting written comments on this document is specified in the public notice published in the *Federal Register* and at https://www.gulfspillrestoration.noaa.gov/restoration-areas/texas. Comments must be postmarked no later than 30 days after the start of the comment period. Comments on this document can be submitted during the comment period by one of following methods:

Online: https://parkplanning.nps.gov/TXRP2

By mail (hard copy), addressed to the following:
U.S. Fish and Wildlife Service
P.O. Box 29649
Atlanta, Georgia 30345

Public webinar: The Texas TIG will hold a webinar on March 9, 2022, at 6 p.m. Central Standard Time. The public may register for the webinar at https://attendee.gotowebinar.com/register/2667653123715836432. After registering, participants will receive a confirmation email with instructions for joining the webinar. The webinar will include a presentation on the RP/EA #2. Public comments will be taken during the webinar. The presentation will be posted on the internet after the webinar is conducted.

Please note that personal identifying information included in submitted comments (e.g., name, address, telephone number, and email address) may be made publicly available as part of the response to comments or through a Freedom of Information Act or Texas Public Information Act request.

1.9.2 Decisions to be Made

The intent of this document is to provide the public and decision-makers with the information and analysis needed to enable meaningful review and comment on the Texas TIG's proposal to proceed with the selection and implementation of one or more of the alternatives proposed in this plan. Projects not included in the RP/EA #2 may be considered in future restoration plans.

1.9.3 Administrative Record

The DWH Trustees opened a publicly available administrative record for the DWH oil spill NRDA, including restoration planning activities, concurrently with publication of the 2010 Notice of Intent (pursuant to 15 CFR Section 990.45). DOI is the federal trustee that maintains the administrative record, which can be found online at http://www.doi.gov/deepwaterhorizon/adminrecord (DOI 2020). This administrative record site is also used by the Texas TIG for DWH restoration planning.

Information about restoration project implementation is provided to the public through the administrative record and other outreach efforts, including online at http://www.gulfspillrestoration.noaa.gov.

1.10 Document Organization

This section describes the organization of the RP/EA #2, which consists of Sections 1 through 6 and six appendices.

- Section 1 (Introduction, Purpose and Need, and Public Participation): Introductory information and context for the RP/EA #2, background on the NRDA restoration planning process, summary of injuries to resources resulting from the DWH oil spill addressed in this document.
- Section 2 (Restoration Planning Process): Identification and evaluation of alternatives for the following restoration types: Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds.
- Section 3 (OPA NRDA Evaluation of Alternatives): Evaluation of the alternatives proposed for NRDA restoration against criteria set forth in OPA, and proposal of a suite of preferred restoration alternatives.
- Section 4 (Environmental Assessment): Description of the affected environment, the environmental consequences, and cumulative impacts for each of the alternatives evaluated in the RP/EA #2.
- Section 5 (Compliance with Other Laws and Regulations): Identification and description of other federal and state laws, in addition to the requirements of OPA and NEPA, that may apply to the preferred alternatives in the RP/EA #2.

- Section 6 (References Cited): List of documents referenced in the RP/EA #2.
- Section 7 (Response to Public Comments): Review of public comments received on the RP/EA #2 (will be added after Draft RP/EA #2 public comment period).
- Appendices (A – Monitoring and Adaptive Management Plans; B – Best Management Practices; C – Reasonably Foreseeable Project List; D – List of Preparers, Reviewers, Repositories; and E – U.S. Department of Agriculture Conservation Practices).

CHAPTER 2 RESTORATION PLANNING PROCESS

Restoration planning started prior to settlement with BP and issuance of the Final PDARP/PEIS. Previous planning work included assessing the injury, developing restoration projects as part of the Early Restoration program undertaken jointly by the DWH Trustees and BP, and planning for programmatic restoration as part of the Final PDARP/PEIS (DWH Trustees 2016a). Upon completion of the settlement, the DWH Trustees created TIGs to implement comprehensive DWH restoration planning in their respective restoration areas. The RP/EA #2 represents a continuation of that restoration planning process.

NRDA restoration under OPA is a process that includes evaluating injuries to natural resources and their services to determine the types and extent of restoration needed to address those injuries. Restoration activities need to produce benefits that are related to or have a nexus (connection) to natural resources or their services that were impacted by an oil spill. Under the OPA NRDA regulations (15 CFR Section 990.54), trustees are to identify and evaluate a reasonable range of alternatives based on criteria outlined within that regulatory subsection.

This chapter describes and summarizes the injury and screening process used by the Texas TIG to identify the reasonable range of alternatives included in the RP/EA #2, consistent with 15 CFR Section 990.53 and the Final PDARP/PEIS (DWH Trustees 2016a: Section 1.3.4). The restoration planning process was conducted in accordance with the OPA, NRDA implementing regulations, and the NEPA, the Consent Decree, and Trustee Council SOPs (Trustee Council 2021).

2.1 Summary of Injuries Addressed in the RP/EA #2

Restoration alternatives identified in the RP/EA #2 are designed to address DWH injuries in the Texas Restoration Area for the following restoration types: Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Sea Turtles; Birds; and Oysters. This section summarizes the information from the Final PDARP/PEIS injury assessment (DWH Trustees 2016a: Chapter 4), which documents the nature, degree, and extent of injuries to natural resources and their services and establishes the nexus for restoration planning for these resources.

2.1.1 Wetlands, Coastal, and Nearshore Habitats

The DWH oil spill and associated response activities caused significant injuries to the nearshore marine ecosystem across the northern Gulf of Mexico, with at least 1,300 miles (2,100 kilometers) of shoreline exposed to oil (DWH Trustees 2016a: Section 4.6). Injuries were detected over a range of species, communities, and habitats. The spill affected a variety of nearshore and coastal resources, including shoreline beaches, sediments, and organisms that live on and in the sand and sediment. Injuries to nearshore resources have cascading impacts throughout the ecosystem that influence the overall health and productivity of the Gulf of Mexico (DWH Trustees 2016a: Section 4.6.9). For example, sand beaches and their associated dunes are integral to the northern Gulf of Mexico ecosystem and play important economic, recreational, and ecological roles. Sand beaches and dunes provide habitat to a diversity of biota, including crabs, snails, worms, and other small organisms, which in turn are food for larger biota such as birds, fish, and turtles (DWH Trustees 2016a: Section 4.6.6).

Nearly all types of nearshore ecosystem habitats in the northern Gulf of Mexico were oiled and injured as a result of the spill, including coastal wetlands. As discussed in the Final PDARP/PEIS, oiling has been documented to adversely affect coastal wetland vegetation and associated fauna. Oil washed onto the marsh edge, contaminating soils, coating vegetation, and penetrating the marsh habitat through tidal creeks and wash-over events, sending the oil in the marsh's interior (DWH Trustees 2016a: Section

4.6.4.1). As a result, live aboveground biomass (wetland vegetation) significantly decreased (Hester et al. 2015, as cited in DWH Trustees 2016a). Wetland vegetation helps stabilize shorelines by holding, retaining, and accumulating sediments; providing coastal flood protection by reducing storm surge and waves; and providing critical structural habitat (as refuge and forage) for a wide variety of organisms (DWH Trustees 2016a: Section 4.11.4).

Animals using the edge of the marsh for refuge and forage were exposed to oil through contact with coated vegetation, soil, sediment, and detritus on the marsh surface as it floods with the tide, as well as through ingestion or contact with oil entrained in submerged sediments. Toxicity testing conducted using marsh soil containing MC252 oil[2] demonstrates that polycyclic aromatic hydrocarbons concentrations found in oiled marsh areas are toxic to many marsh species (Morris et al. 2015, as cited in DWH Trustees 2016a). The Final PDARP/PEIS determined that injuries to marsh flora and fauna can persist until oil concentrations in marsh soils fall below levels that are toxic to the most sensitive prey species and life stages (DWH Trustees 2016a: Section 4.6). Overall, both direct and indirect impacts to the productivity of wetland, coastal, and nearshore habitats through ecological and physical relationships such as food-web dynamics, organism movements, nutrient and sediment transport and cycling, and other fundamental ecosystem processes occurred.

2.1.2 Nutrient Reduction (Nonpoint Source)

Nutrient pollution poses a significant threat to localized watersheds across the entire Gulf Coast, including Texas. Eutrophication, or the process in which a body of water becomes excessively enriched with nutrients, increasing the amount of plant and algae growth in estuaries and coastal waters, is a chronic threat. Excessive nutrient loading leads to hypoxia (low oxygen levels), harmful algal blooms, habitat losses, and fish kills (NOAA 2021c). Reducing nutrient loading helps address the pervasive ecosystem threats incurred by eutrophic Gulf Coast waters (DWH Trustees 2016a: Section 5.5.4).

Under the goal of restoring water quality, the DWH Trustees identified the restoration type Nutrient Reduction (Nonpoint Source) because they recognized that addressing nutrient pollution contributes to the overall health and resiliency of coastal ecosystems, in particular the nearshore ecosystem (DWH Trustees 2016a: Section 4.6). Addressing injuries in the nearshore environment is complex, and nutrient reduction assists in addressing these injuries by benefitting the estuaries that are integral habitats for providing food, shelter, and nursery grounds to many of the Gulf of Mexico’s ecologically and economically important species (e.g., fish) (DWH Trustees 2016a: Section 5.5.4).

Nutrient reduction involves a suite of restoration activities and conservation practices to reduce nutrient loading, depending on the watershed and site characteristics. Agriculture and its associated land use practices (e.g., application of fertilizer and concentrated animal farm operations) is a principal source of elevated nutrient loads along the Gulf Coast (DWH Trustees 2016a: Section 5.5.4.2). In Texas, agricultural land accounts for approximately 78% of the land use (USDA 2021). Implementation of a variety of agricultural best management practices (BMPs), ranging from structural to non-structural (e.g., installation of vegetated buffer, implementation of conservation tillage, etc.) could reduce nutrient concentrations from agricultural lands along Texas’s coastal watersheds.

[2] Crude oil released from the Macondo well MC252 during the spill.

2.1.3 Oysters

The DWH Trustees evaluated the toxicity and injury of oil to benthic marine resources as part of the benthic and nearshore resources toxicity testing work (DWH Trustees 2016a: Sections 4.5 and 4.6). Documented injuries to both subtidal and nearshore oysters resulted in a loss of ecological services provided by these organisms.

Oysters play a unique role in the coastal ecosystem, providing filtration that leads to improved water quality and clarity and habitat for economically and ecologically important marine species. They serve not only as a harvestable resource, but also provide habitat for other aquatic organisms, such as shrimp, crab, and finfish. Oyster reefs adjacent to marshes reduce marsh erosion; when these reefs were injured, erosion increased (DWH Trustees 2016a: Section 4.6.1.2.1). Oysters are considered “ecosystem engineers” for their role in creating reefs that modify, through their physical presence, the surrounding environment while providing habitat, refuge, and foraging areas for many other species including benthic organisms and fish (e.g., Powers et al. 2009; VanderKooy 2012; Wong et al. 2011, as cited in DWH Trustees 2016a).

As discussed in the Final PDARP/PEIS (DWH Trustees 2016a: Section 4.6), exposure to oil injured large populations of oysters occupying most of the estuaries along the northern Gulf of Mexico. Billions of subtidal oysters (approximately four to 8.3 billion adult equivalents) were killed by releases of freshwater, from cleanup actions, and from the effects to nearshore oysters from shoreline oiling (DWH Trustees 2016a: Section 4.6). Nearshore oyster cover in the northern Gulf was significantly reduced over 155 miles of shoreline, resulting in the loss of 8.3 million adult-equivalent oysters. An additional estimated 5.7 million oysters per year (adult equivalents) are still unable to settle because of the loss of oyster shell cover in reef habitats (DWH Trustees 2017a). The loss of oyster reef habitat has contributed to a lack of recruitment and recovery for oysters and has also contributed to shoreline erosion rates and wetland loss. Reduced larval production, spat settlement, and spat substrate availability have compromised the sustainability of oyster reefs. Loss of oyster reefs along oiled shorelines have been associated with accelerated coastal erosion.

2.1.4 Sea Turtles

The DWH oil spill caused significant injuries to five species of sea turtles, including those species most often found in Texas: the loggerhead (*Caretta caretta*), Kemp’s ridley (*Lepidochelys kempii*), green sea turtle (*Chelonia mydas*), and hawksbill (*Eretmochelys imbricata*) (DWH Trustees 2016a: Section 4.8). All five sea turtle species (including the leatherback [*Dermochelys coriacea*], which occur primarily in the deeper Gulf of Mexico waters off the coast of Texas), and their habitats were injured as a result of the spill and response activities in the open ocean, across the continental shelf, and into nearshore and coastal areas, including beaches. The resulting mortality spans multiple life stages (DWH Trustees 2016a: Section 4.8).

As discussed in the Final PDARP/PEIS (DWH Trustees 2016a: Section 4.8.3), sea turtles were injured by the spill through multiple pathways including direct contact with oil when swimming at or near the surface and on nesting beaches; inhalation of oil droplets, oil vapors, and smoke; ingestion of oil-contaminated water and prey; transfer of oil compounds from adult females to their developing embryos; and oil contamination of essential turtle habitats. Response activities and shoreline oiling related to the spill also directly injured sea turtles and disrupted or deterred sea turtle nesting in the Gulf of Mexico. The DWH Trustees estimated that thousands of juvenile and adult Kemp’s ridleys, loggerheads, hawksbills, and green sea turtles died as a result of the spill (DWH Trustees 2016a: Section 4.8.5). Thousands more Kemp’s ridley and loggerhead hatchlings were lost because of unrealized reproduction by adult sea turtles that were killed by the spill. In addition, leatherback turtles were determined to have been injured, but this injury could not be quantified (DWH Trustees 2017b).

2.1.5 Birds

The DWH oil spill affected multiple northern Gulf habitats, including open water, islands, beaches, bays, and marshes (DWH Trustees 2016a: Section 4.7.1). At least 93 bird species were significantly injured through physical contact with oil in the environment; ingestion of external oil during preening; and ingestion of oil while foraging and consuming contaminated prey, water, or sediment (DWH Trustees 2016a: Section 4.7). The Trustees estimated that between 51,600 and 84,500 birds died because of the spill. Of those quantified dead birds, breeding-age adults would have produced an estimated 4,600 to 17,900 fledglings. The Trustees recognize that additional injury occurred that is unquantified; true bird mortality is likely closer to the upper ranges than the lower (DWH Trustees 2016a: Section 4.7). These estimates only represent a portion of total bird injuries because they do not reflect all injuries that may have occurred to marsh birds and colonial waterbirds, as well as nonlethal injuries such as impaired health.

2.2 Screening for Reasonable Range of Alternatives

The Texas TIG reviewed the Final PDARP/PEIS Programmatic Trustee Goals and developed a set of selection criteria (https://www.doi.gov/deepwaterhorizon/adminrecord) for identifying projects to develop a reasonable range of alternatives for restoration in the RP/EA #2. The Texas TIG prioritized five restoration types described in the Final PDARP/PEIS (Wetlands, Coastal, and Nearshore Habitat; Nutrient Reduction; Oysters; Sea Turtles; and Birds) for inclusion in this document.

The project screening process developed by the Texas TIG for the purpose of preparing this document included ideas submitted by the public via the Restore the Texas Coast and NOAA Gulf Spill Restoration web portals. Project submissions began on October 1, 2020, and continued through December 10, 2020. The Texas TIG reviewed more than 120 restoration ideas proposed by the public, non-governmental organizations (NGOs), and state, federal, and local agencies. Projects within the Texas Restoration Area from both web portals identified above were combined, and a cumulative project list was then sorted by the restoration types identified in the Final PDARP/PEIS. Projects were considered for funding in more than one Restoration Type where appropriate.

The Texas TIG project screening process is illustrated below. Project review and screening took place in several stages and is broadly presented in Figure 2-1. Figure 2-1 lists each stage and the number of projects that remained at the end of each stage. Table 2-1 outlines the criteria considered by the Texas TIG during the project screening process.

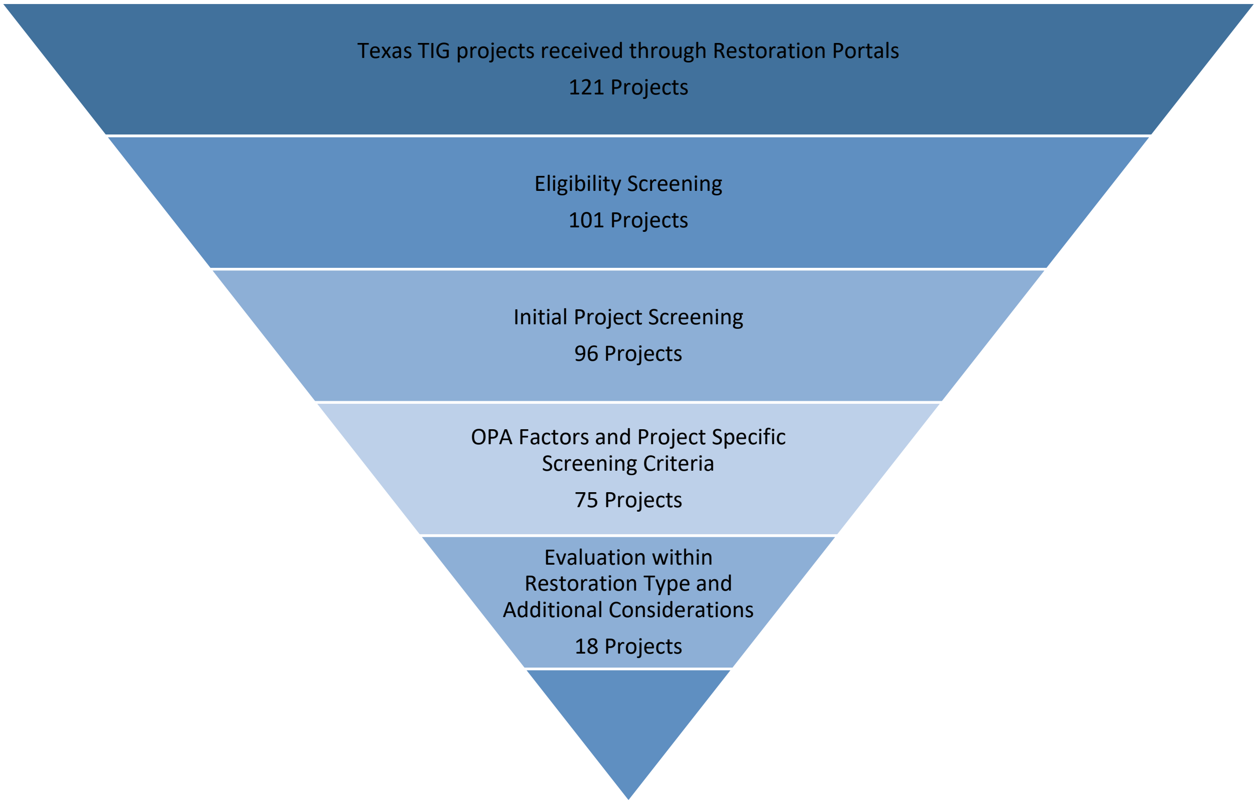

Figure 2-1. Overview of Texas TIG screening process.

Table 2-1. Alternative Screening Process

Stage of Screening	Criteria
Eligibility Screening	1. Project benefits resources in the Texas Restoration Area. 2. Project replenishes and protects one or more restoration type identified in the Final PDARP/PEIS (DWH Trustees 2016a). 3. Project proposal is unique and avoids duplicating efforts of other proposals*
Initial Project Screening	1. Project addresses one or more technique and/or approach identified in the Final PDARP/PEIS (DWH Trustees 2016a). 2. Project is not explicitly required by local, state, or federal law, order, or permit. 3. Project requires funding for implementation. 4. Project proposal provides sufficient information for project screening.

Stage of Screening	Criteria
OPA Factors and Project Specific Screening Criteria	*OPA factors* 1. Project prevents future injury and collateral damage to natural resources and services. 2. Project is technically feasible and has a reasonable likelihood of success considering the uncertainty or risk involved in project implementation. 3. Project does not adversely affect public health and safety. 4. Project delivers benefits cost-effectively. 5. Project benefits multiple natural resources and/or services. 6. Project has reasonable probability of success: organizational feasibility. *Project-specific screening criteria* 1. Project implements at least one priority approach and/or technique identified in the public notice. 2. Project complies with all applicable laws and regulations. 3. Project supports existing conservation efforts or plans. 4. Project is expected to yield restoration benefits within a reasonable/acceptable amount of time. 5. Project is sustainable, provides long-term benefits to natural resources and services. 6. Project leverages external funding or collaboration.
Evaluation within Restoration Type and Additional TIG Considerations	Remaining projects were sorted into Restoration Type, then ranked according to tallied score from previous screening steps. The criteria below were used to evaluate the top-ranked projects and identify the reasonable range of alternatives: 1. Does the project have a direct nexus with the injury caused by the DWH oil spill? 2. Would the project provide restoration benefits commensurate with overall costs? 3. Does the project involve or enhance partnerships? 4. Does the project address a time-critical restoration need? 5. Does the project create synergies with other ongoing restoration projects and programs? 6. Is the project ready to be constructed? 7. How long until construction begins? 8. Is permitting completed for the project? 9. Is environmental compliance completed for the project?

*Duplicate projects were tracked for reference purposes only.

2.3 Natural Recovery/No Action Alternative

In accordance with the OPA NRDA regulations, the Final PDARP/PEIS considers a "natural recovery alternative in which no human intervention would be taken to directly restore injured natural resources and services to baseline" (15 CFR Section 990.53[b][2]). Under a natural recovery alternative, no additional restoration would be conducted by the Trustees to accelerate the recovery of injured natural resources or to compensate for lost services and the Trustees would allow natural recovery processes to occur. The Final PDARP/PEIS (DWH Trustees 2016a:5–92) notes that interim losses of natural resources, and the services natural resources provide, would not be compensated under a natural recovery alternative. Given that technically feasible restoration approaches are available to compensate for interim natural resource and service losses, the Trustees rejected this alternative from further OPA evaluation within the Final PDARP/PEIS (DWH Trustees 2016a).

Based on this determination, tiering the RP/EA #2 from the Final PDARP/PEIS, and incorporating that analysis by reference, the Texas TIG did not further evaluate natural recovery as a viable alternative in this document.

2.4 Alternatives Considered but Not Carried Forward for Further Evaluation

This section provides a summary of project screening for the 121 alternatives considered. There were 20 projects that were not related to the restoration types identified on the NOS, and they were not evaluated. The remaining 101 project submittals included project activities that would provide benefits to restore wetland, coastal, and nearshore habitats; improve water quality (nutrient reduction); and restore sea turtles, birds, and oysters and were evaluated under the project screening process described in Section 2.2. Projects were considered for funding in more than one Restoration Type where appropriate. This process narrowed the remaining projects to a reasonable range of alternatives considered in the RP/EA #2. The remaining projects were not carried forward for further evaluation in this plan.

Out of the 60 projects that were considered under the Wetland, Coastal, and Nearshore Habitats restoration type 55 were not evaluated further for the RP/EA #2. These projects 1) were not unique and duplicated other proposed efforts, 2) did not require funding for implementation, 3) did not provide sufficient information for project screening, or 4) failed to rank highly after being considered for OPA Factors, project specific screening criteria and other TIG considerations.

Out of the five projects considered in the Nutrient Reduction (Nonpoint Source) restoration type, one project was not evaluated further because it failed to provide sufficient information for screening. Out of the remaining four project ideas, two of them were combined to form a single project and all three projects were evaluated as part of the reasonable range of alternatives.

There were 17 projects considered under the Oyster restoration type and 15 were not evaluated further. Five projects were not evaluated further because they failed to address one or more technique and/or approach identified in the Final PDARP/PEIS (DWH Trustees 2016a) or did not provide sufficient information for project screening. Nine of the projects failed to rank highly after being considered for OPA Factors, project specific screening criteria and other TIG considerations. One additional oyster alternative was excluded during preparation of this document because the Texas TIG determined that funding was not needed.

From the 21 projects evaluated under the Birds restoration type, 16 were not evaluated further. Four projects were not evaluated further because they 1) did not benefit resources in the Texas Restoration Area, 2) failed to provide sufficient information for project screening, or 3) failed to prevent future injury and collateral damage to natural resources and services. The remaining nine projects were not evaluated further because they failed to rank highly after being considered for OPA Factors, project specific screening criteria and other TIG considerations.

Out of the eight projects evaluated under the Sea Turtles restoration type, five were not evaluated further. These projects failed to rank highly after being considered for OPA Factors, project specific screening criteria and other TIG considerations.

2.5 Reasonable Range of Restoration Alternatives Considered

Projects that were evaluated through the four-step screening process (as described in Section 2.2) and were not eliminated from further evaluation (as described in Section 2.4) were developed by the Texas TIG as a reasonable range of alternatives for further consideration and evaluation.

The screening criteria were developed to ensure that projects that could be advanced would provide the greatest benefits to resources injured in the Texas Restoration Area. Alternatives carried forward in the reasonable range address the restoration goals of one or more of the restoration types covered in this plan effectively and in a timely fashion (Table 2-2; see Figure 1-1). It should be noted that projects screened out at any step remain in the Trustee and state portals and may be eligible for future restoration planning efforts.

The Final PDARP/PEIS provides the structure for the TIGs to propose different strategies to implement or propose phased restoration projects across multiple restoration plans. For example, a TIG may propose funding a planning phase (e.g., initial engineering and design [E&D] and compliance) in one restoration plan for a conceptual project (DWH Trustees 2016a: Section 6.4.14). This approach allows the TIGs to develop projects to the extent needed to fully consider a subsequent implementation phase of that project in a future restoration plan. The Texas TIG proposes this strategy for alternatives that do not include implementation. One of the nutrient reduction alternatives only includes planning, feasibility, design, engineering, and permitting activities (hereafter identified as an “E&D” project). E&D projects can be proposed as a preliminary planning phase of a project to allow the Texas TIG to conduct a range of activities that would provide information necessary to consider a subsequent implementation phase in a future restoration plan (DWH Trustees 2016a: Section 6.4.14).

Table 2-2. The Reasonable Range of Restoration Alternatives Proposed in the RP/EA #2 by Restoration Type

Reasonable Range of Restoration Alternatives	Alternative Cost
Wetlands, Coastal, and Nearshore Habitat Alternatives	
Bird Island Cove Habitat Restoration - Construction	$5,000,000
Bahia Grande Channel F Hydrologic Restoration	$1,500,000
Follets Island Habitat Acquisition Phase 2	$3,300,000
Galveston Island Habitat Acquisition	$1,120,000
Matagorda Peninsula Habitat Acquisition	$1,300,000
Nutrient Reduction (Nonpoint Source) Alternatives	
Petronila Creek Constructed Wetlands Planning (E&D only)	$450,000
Petronila Creek Watershed Nutrient Reduction Initiative	$4,300,000
Petronila Creek Crooked Ditch Restoration	$6,500,000
Oyster Alternatives	
Landscape Scale Oyster Restoration in Galveston Bay	$9,500,000
St. Charles Bay Oyster Reef Restoration	$2,500,000

Reasonable Range of Restoration Alternatives	Alternative Cost
Sea Turtle Alternatives	
Upper Texas Coast Sea Turtle Rehabilitation Facility	$2,500,000
Lancha Sea Turtle Mitigation Plan	$2,220,000
Kemp’s Ridley Sea Turtle Nest Protection	$2,200,000
Bird Alternatives	
Laguna Vista Rookery Island Habitat Protection	$2,100,000
Jones Bay Oystercatcher Habitat Restoration	$2,300,000
San Antonio Bay Bird Island	$1,500,000
Texas Breeding Shorebird and Seabird Stewardship Project	$3,400,000
Gulf Cut Bird Islands Restoration	$13,500,000

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CHAPTER 3 OPA NRDA EVALUATION OF ALTERNATIVES

According to the NRDA regulations under OPA (15 CFR Section 990), trustees are responsible for considering a reasonable range of alternatives (15 CFR Section 990.53(a)2) that can be evaluated based on the OPA evaluation standards (15 CFR Section 990.54(a)). Section 2 describes the screening process used to identify a reasonable range of alternatives for the RP/EA #2. Once a reasonable range of alternatives has been developed, the trustees will evaluate those alternatives based on the following criteria (15 CFR Section 990.54(a)):

- The cost to carry out the alternative.
- The extent to which each alternative 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 (the ability of the alternative to provide comparable resources and services; that is, the nexus between the project and the injury).
- The likelihood of success of each alternative.
- The extent to which each alternative will prevent future injury as a result of the DWH oil spill, and avoid collateral injury as a result of implementing the alternative.
- The extent to which each alternative benefits more than one natural resource and/or service.
- The effect of each alternative on public health and safety.

If the Trustees conclude that two or more alternatives are equally preferable, the regulations provide that the most cost-effective alternative be chosen (15 CFR Section 990.54(b)).

The following section describes the Texas TIG evaluation process used to identify the preferred alternatives. This process was based on the OPA criteria found in 15 CFR Section 990.54(a), as well as the Final PDARP/PEIS (DWH Trustees 2016a). This evaluation is separate from the alternatives screening process detailed in Section 2 that was used to develop the reasonable range of alternatives. See Section 2.2 above and Section 3.1 below for a discussion of these separate processes.

3.1 Summary of OPA NRDA Evaluation Criteria

3.1.1 Project Costs

The following questions were asked in the evaluation of each alternative:

- Is there a description of the anticipated costs of the alternative?
- Are the costs of the alternative (including land acquisition, design, construction, management, monitoring, and maintenance) reasonable, appropriate, and comparable to other equivalent restoration alternatives?

3.1.2 Texas TIG Restoration Goals and Objectives

The Texas TIG's analysis considered the extent to which each alternative addressed restoration types and goals established in the Final PDARP/PEIS. The Texas TIG also considered whether each alternative has a clear nexus to the injuries described in the Final PDARP/PEIS and is consistent with one or more approaches identified in that overarching document (DWH Trustees 2016a).

3.1.3 Likelihood of Success

The likelihood of success for each alternative was analyzed using a series of criteria:

- The alternative proposes restoration approaches and techniques that the Texas TIG has previously executed successfully, or are routinely used, or, if the project is a novel approach, whether there is a documented high probability of success.
- Whether management measures and project partners are sufficient to ensure successful long-term, sustainable implementation.

3.1.4 Prevent Future Injury and Avoid Collateral Injury

The extent to which each alternative would prevent future injury (a result of the DWH oil spill) and avoid collateral injury (a result of implementing the alternative) was analyzed using the following criteria:

- Whether alternatives prevent future injury to natural resources and services and minimizes the potential to adversely affect surrounding habitats and resources during implementation.
- Whether alternatives are compatible with surrounding land use.

In addition, the Texas TIG analyzed whether project activities might contaminate the surrounding area or conflict with the viability of endangered species populations. Many of these considerations are covered in the Affected Environment and Environmental Consequences sections of the RP/EA #2 (Section 4).

3.1.5 Benefits to Multiple Resources

Although each alternative is funded exclusively from one restoration type allocation, the Texas TIG considered the importance of multiple resource benefits from each alternative. This was done by evaluating whether alternatives convey multiple ecosystem service benefits that make them more valuable to the public and ecological resources injured by the DWH oil spill.

3.1.6 Public Health and Safety

The Texas TIG considered whether there are any aspects of the alternative that could adversely affect public health and safety that cannot be mitigated.

3.2 Considerations for all Alternatives

The Implementing Trustee(s) have been identified in the description for each alternative based on the Texas TIG's current understanding of how these alternatives would be implemented. However, the Texas TIG acknowledges that the Implementing Trustee(s) could change. For alternatives selected for implementation in the Final RP/EA #2, the Implementing Trustee(s) would be identified in a Trustee Resolution that authorizes funding for that project alternative.

The cost provided for each alternative also reflects current cost estimates developed from the most recent designs and information available to the Texas TIG at the time of drafting the RP/EA #2. Some alternatives would require additional cost sharing from other sources beyond those funds allocated in this document. If selected by the Texas TIG in the Final RP/EA #2, these alternatives would only be funded by the Texas TIG if funding from other sources is secured so that the alternative can be fully implemented.

3.3 OPA NRDA Evaluation of Alternatives for the Wetlands, Coastal, and Nearshore Habitat Restoration Type

3.3.1 Bird Island Cove Habitat Restoration - Construction

3.3.1.1 PROJECT DESCRIPTION

The Bird Island Cove Habitat Restoration - Construction proposed alternative is located in West Galveston Bay, at the mouth of Ostermayer Bayou, around and in front of Shell Island Point, Bird Island Cove, and McAllis Point (Figure 3-1). This alternative would protect sensitive estuarine marshes from continued erosion via finalization of E&D, would construct a breakwater, and would include monitoring. A total of $5,000,000 in funding would be provided under this proposed alternative; remaining funding for the total estimated project cost of $7,500,000 would come from other secured sources. If selected by the Texas TIG in the Final RP/EA #2, this alternative would only be implemented if funding through other sources is allocated so that the entire project can be implemented.

West Galveston Bay and the larger Galveston Bay System in Galveston County, Texas, has lost nearly 20% of wetlands due to subsidence and erosion (White et al. 1993). Historical subsidence experienced by this coastal region inundated thousands of acres of coastal marsh and exposed shorelines to greater wave activity, resulting in erosion and loss of marsh habitat. Previous habitat restoration efforts in the area in 2015 have not resulted in desired restoration outcomes for estuarine marsh complex.

This alternative builds upon the Bird Island Cove Habitat Restoration Engineering project (Portal ID #102; https://www.gulfspillrestoration.noaa.gov/project?id=102) approved in the TX TIG RP/EA #1 (Texas TIG 2017). Funding of that engineering project provided initial planning and E&D steps to more effectively address ongoing habitat degradation. Lessons learned from the previous engineering project would be used to improve implementation success. However, the Texas TIG's decision regarding this alternative is independent of the previous engineering project and is conditional on analysis in the RP/EA #2.

This alternative would include 1) completion of the final engineering design, conduct and update surveys, develop a MAM plan, and prepare a solicitation; 2) construction of riprap concrete or limestone breakwaters adjacent to the shoreline of Bird Island Cove, Ostermayer Bayou, and Shell Island Point; and 3) monitoring. The TGLO would be the Implementing Trustee.

This alternative would construct approximately 8,820 linear feet (LF) of riprap breakwaters to protect and enhance existing estuarine marsh habitats. The breakwaters would be constructed to an elevation of approximately 3.5 feet NAVD88[3] with a backhoe on a barge. Approximately 2,000 LF would follow the alignment of geo-textile tubes that were previously constructed. The breakwaters would be constructed of either limestone or clean concrete. The breakwaters would protect up to 85 acres of natural estuarine marsh complex, (approximately 67 acres of intertidal emergent marsh interspersed with shallow open water seagrass beds and approximately 18 acres of vegetated and non-vegetated sand flats) and create approximately 17,640 LF of three-dimensional hard-structure habitat for fisheries species. The interstitial space between rocks provides cover habitat to many of the same crustacean species using oyster reefs (porcelain crab species, mud crab species, and snapping shrimp), as well as finfish species. Rock breakwaters provide a hard surface for encrusting species (oyster and others mentioned above) and filamentous algae to attach. These habitat features attract other invertebrates (e.g., amphipods, isopods, and copepods), which attract other fishery species (e.g., planktivorous, carnivorous, and scavengers).

[3] North American Vertical Datum of 1988 (NAVD 88) is the vertical control datum established in 1991 by the minimum-constraint adjustment of the Canadian-Mexican-United States leveling observations establishing a standard measurement for sea level. North American Vertical Datum of 1988 (NAVD 88) consists of a leveling network on the North American Continent, ranging from Alaska, through Canada, across the United States, affixed to a single origin point on the continent.

To facilitate site access, approximately 13,500 LF of flotation channels could be constructed with a hydraulic dredge. If flotation channels are constructed, then the dredged material would be used beneficially to create an additional 12 acres, approximately, of marsh mound consisting of estuarine marsh complex (intertidal emergent marsh interspersed with shallow open water and vegetated and non-vegetated sand flat). The dredged material would be pumped to an elevation between 2.1 to 2.5 NAVD88 to create marsh mounds. The selected elevation range would consider and allow for bulking (compaction of the dredge material as it dewaters) and sea-level rise. Portions of the dredge material would be placed above intertidal elevation and would be suitable elevation for restoring salt flat marsh/sand flat habitat in addition to intertidal *Spartina alterniflora* marsh. Dredge placement would also allow for the migration of intertidal marsh to higher elevations in response to sea level rise. This proposed marsh restoration technique has been successfully used at multiple other restoration sites (e.g., Jumbile Cove, Delehide Cove, Starvation Cove, Carancahua Cove, and McAllis Point) in West Galveston Bay. Resiliency, sea level rise, and other environmental factors would be considered during E&D. The Texas TIG anticipates that the alternative would be designed for a 20- to 25-year life span.

The MAM plan for this proposed alternative is in Appendix A.

Figure 3-1. Bird Island Cove Habitat Restoration - Construction location map.

3.3.1.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Bird Island Cove Habitat Restoration – Construction	**Cost-effectiveness:** The estimated cost of this proposed alternative is $5,000,000 to be funded from Wetlands, Coastal and Nearshore Habitat restoration type dollars. This amount, combined with additional funding from other sources, would be used to fund the total estimated cost of $7,500,000. This cost is comparable to other similar restoration projects including the Indian Point Shoreline Erosion Protection project funded by the Texas TIG in TX TIG RP/EA #1 ([Portal ID #106; https://www.gulfspillrestoration.noaa.gov/project?id=106]; Texas TIG 2017). The Texas TIG has experience implementing similar projects cost effectively and have deemed the cost reasonable and appropriate. This alternative is also cost effective because it leverages other sources of funding and the project would only be implemented if sufficient funding is allocated so that that the entire project can be implemented.
	Goals and objectives: The proposed alternative would protect sensitive estuarine marshes from continued erosion via finalization of E&D, would construct a breakwater, and would include monitoring; therefore, it is consistent with the programmatic Trustee goal of Restore and Conserve Habitat and the Wetlands, Coastal, and Nearshore Habitats restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to injuries to coastal habitats and is consistent with the restoration approach to create, restore, and enhance coastal wetlands (DWH Trustees 2016a), which supports, protects, and restores a wide variety of coastal, wetland and estuarine habitats and their ecosystem services. This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative is technically feasible and uses proven techniques with established methods and documented results. Additionally, lessons learned from the previous engineering project will improve implementation success. The Texas TIG has a proven record of successfully implementing similar projects and the alternative would have a high likelihood of being successful.
	Prevents future injury and avoids collateral injury: Aside from the potential for minor disturbances during construction, the proposed alternative is not expected to cause substantive collateral injury to natural resources. The proposed alternative would avoid and minimize collateral injury to the aquatic habitat and species that may use either the area or constructed oyster reef complexes through implementation of BMPs described in the Final PDARP/PEIS (DWH Trustees 2016a).
	Benefits multiple resources: This alternative would protect sensitive estuarine marshes, which would benefit multiple resources including habitat for birds, fish, and invertebrates, and would also provide recreational opportunities for fishing and birding. In addition, with the reduction in erosion this alternative would improve water quality.
	Public health and safety: This alternative would minimize potential effects to public health and safety during construction by implementing BMPs and complying with all U.S. Coast Guard requirements. In addition, construction of the breakwaters would benefit health and safety by protecting estuarine marsh systems that shield public infrastructure from wave action and erosion and improve coastal resiliency and water quality.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets Trustees goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.3.2 Bahia Grande Channel F Hydrologic Restoration

3.3.2.1 PROJECT DESCRIPTION

The Bahia Grande Channel F Hydrologic Restoration proposed alternative is located within the Laguna Atascosa National Wildlife Refuge between Bahia Grande and Laguna Vista, Texas (Figure 3-2). The Bahia Grande System is a federally protected 10,000-acre coastal ecosystem estuary and wetland complex consisting of three shallow water basins (i.e., Bahia Grande, Little Laguna Madre, and Laguna Larga). This alternative proposes to enhance 800 acres of wetlands and shallow open waters by restoring freshwater flow from north of Highway 100 to Laguna Larga in the upper Bahia Grande System. A total of $1,500,000 in funding would be provided by the Texas TIG; remaining funding for the total estimated project cost of $2,400,400 would come from other secured sources. If selected by the Texas TIG in the Final RP/EA #2, this alternative would only be implemented if sufficient funding through other sources is allocated so that the entire project can be completed.

The Bahia Grande System served as a natural nursery for fish, shellfish, wildlife, and waterfowl in the South Texas coastal region until the basin was modified by the placement of dredged sediments from the construction of the Brownsville Ship Channel in the mid-1930s and subsequently by the construction of State Highway 48 in the mid-1950s. This isolation left the Bahia Grande System a vast flat of dry sediment with little to no value as habitat for fish and wildlife. In the early 2000s, the USFWS proposed to flood Bahia Grande by cutting in a channel from the Brownsville Ship Channel. The pilot channel was constructed in 2005 and flooded Bahia Grande. Additionally, a bridge constructed on State Highway 48 in 2007 improved water exchange between the ship channel and Bahia Grande via the pilot channel (Coast and Harbor Engineering 2011). Another project (Bahia Grande Hydrologic Restoration [Portal ID #99; https://www.gulfspillrestoration.noaa.gov/project?id=99]) was funded through the TX TIG RP/EA #1 that included widening and deepening the existing pilot channel between Bahia Grande and the Brownsville Ship Channel, reestablishing a higher tidal exchange between Laguna Madre/Gulf of Mexico and the Bahia Grande.

This alternative builds upon E&D work funded in the 2015 RESTORE Funded Priority List 1. If this alternative is selected, the alternative would contribute to the implementation of the designed project that restores the flow of freshwater from north of Highway 100 to Laguna Larga in the upper Bahia Grande System. This alternative would include 1) final engineering design and solicitation; 2) land grading and construction of a conveyance channel; and 3) monitoring.

Restoration of the natural hydrology to the Laguna Larga would benefit 800 acres of the Bahia Grande System. This would be accomplished by the modification of ditches, installation of box culverts under Highway 100, and the construction of a conveyance channel (Channel F) to route water flow into Laguna Larga. Land grading would be needed to ensure the desired water flow into Laguna Larga. Reestablishing freshwater flow into Laguna Larga would complement the tidal flow restoration between the Brownsville Ship Channel and the Bahia Grande. NOAA would be the Implementing Trustee. The Laguna Atascosa National Wildlife Refuge would be responsible for the long-term maintenance of the restored wetlands and waters.

The MAM plan for this proposed alternative is in Appendix A.

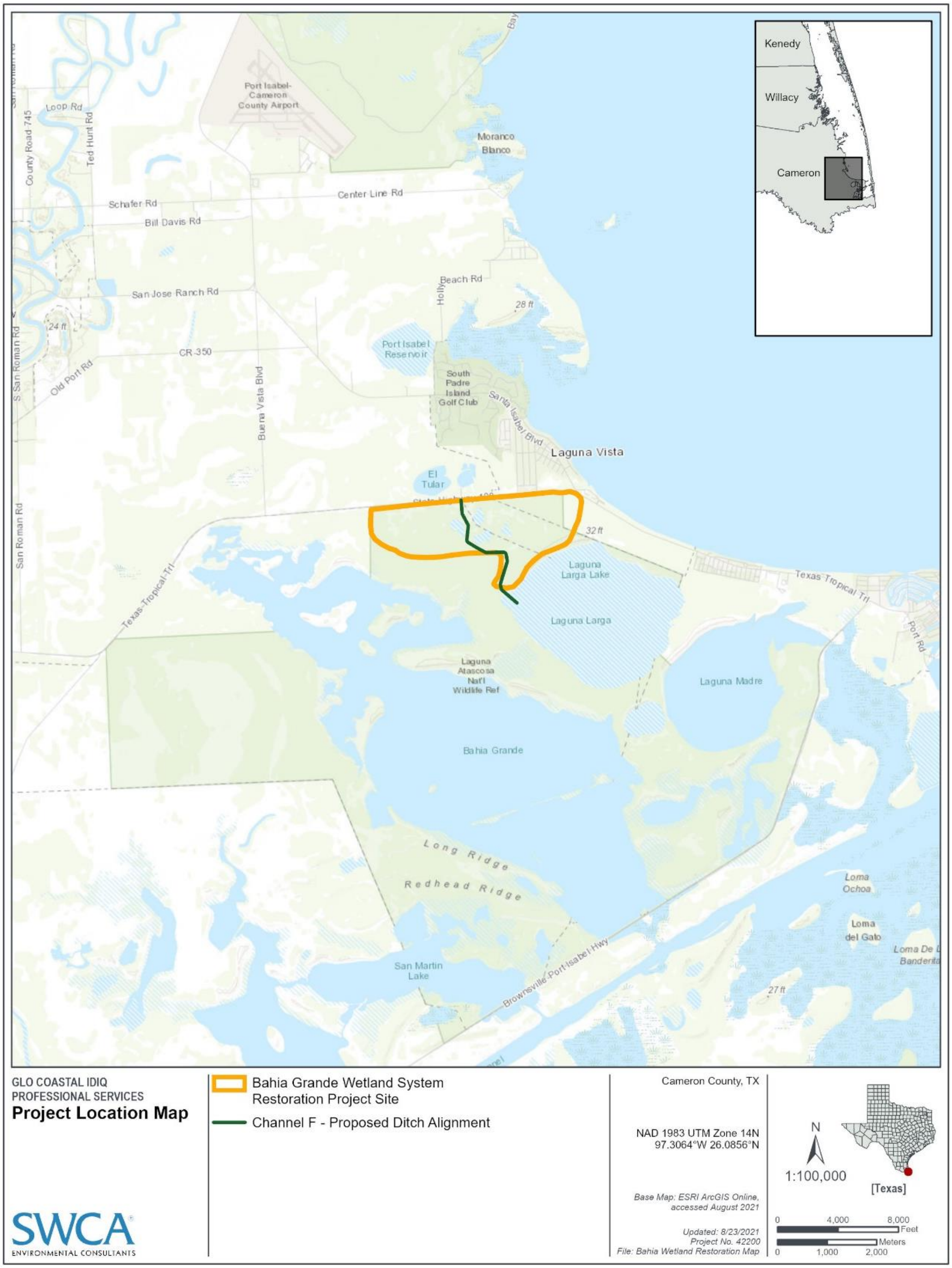

Figure 3-2. Bahia Grande Channel F Hydrologic Restoration location map.

3.3.2.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Bahia Grande Channel F Hydrologic Restoration	**Cost-effectiveness:** The estimated cost of this proposed alternative is $1,500,000 to be funded from Wetlands, Coastal, and Nearshore Habitat restoration type dollars. This amount, combined with additional funding from other sources, would be used to fund the total estimated cost of $2,400,400. Since the Texas TIG has experience implementing other restoration projects cost effectively in the Bahia Grande system, the Texas TIG has deemed the cost reasonable and appropriate. This alternative is also cost effective because it leverages other sources of funds and would only be implemented if sufficient funding is allocated so that that the entire project can be implemented.
	Goals and objectives: The proposed alternative would enhance 800 acres of wetlands and shallow open waters by restoring freshwater flow in the upper Bahia Grande System and is therefore consistent with the programmatic Trustee goal of Restore and Conserve Habitat and the Wetlands, Coastal, and Nearshore Habitats restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to injuries to coastal habitats, is consistent with the restoration approach to create, restore, and enhance coastal wetlands (DWH Trustees 2016a) and would enhance the ecosystem services they provide. This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative would rely upon ongoing E&D work (funded in the 2015 RESTORE Funded Priority List 1). The project is technically feasible and uses proven techniques with established methods and documented results. The Texas TIG has a proven record of successfully implementing similarly scaled efforts to restore wetland habitat and aquatic ecosystems with different restoration techniques, including, wetland construction, or installation of water control structures (Texas TIG 2017). Therefore, the proposed alternative would have a high likelihood of being successful.
	Prevents future injury and collateral injury: Although some temporary effects to species and habitats in the project vicinity may occur during construction, the proposed alternative is not expected to cause substantive collateral injury to natural resources. The proposed alternative would avoid and minimize collateral injury to aquatic habitat and species through implementation of construction BMPs described in the Final PDARP/PEIS (DWH Trustees 2016a).
	Benefits multiple resources: This alternative would restore freshwater flows, which would benefit wetland and estuarine habitats and benefit multiple resources including habitat for birds, fish, crabs, etc., and would also enhance recreational opportunities for fishing and birding. In addition, this alternative would reduce sedimentation, thus improving water quality.
	Public health and safety: This alternative would minimize potential effects to public health and safety during construction by implementing BMPs. In addition, restoration would benefit health and safety by protecting estuarine marsh systems from sea level rise and improve coastal resiliency.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets the Trustees' goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.3.3 Follets Island Habitat Acquisition Phase 2

3.3.3.1 PROJECT DESCRIPTION

The Follets Island Habitat Acquisition Phase 2 proposed alternative is located on Follets Island, which is a USFWS-recognized nationally significant coastal barrier ecosystem in Brazoria County, Texas. Its northern coastline abuts Christmas Bay, which is a designated coastal preserve, and Drum Bay borders the northwest coastline (Figure 3-3). This alternative proposes to obtain and conserve approximately 350 acres of wetland, coastal, and nearshore habitats on Follets Island, Texas, in perpetuity through fee-simple acquisition for inclusion in the existing Follets Island Coastal Management Area (CMA). The estimated total cost of this proposed alternative is $3,300,000.

Follets Island supports a diversity of wildlife within its marsh, mud flat, beach, dune, and other suitable habitat. Moreover, important foraging, roosting, and nesting habitat for multiple federally protected species are located on the island. Since 2011, the number of beach development permits on Follets Island has steadily increased (Texas TIG 2017), putting significant pressure on the island's natural resources.

This alternative builds upon the Follets Island Habitat Acquisition project (Portal ID #105; https://www.gulfspillrestoration.noaa.gov/project?id=105) that was approved in TX TIG RP/EA #1 (Texas TIG 2017). Funding of that acquisition project is helping to preserve the island's ecological services through the acquisition of wetland and coastal habitat. If this alternative is selected, the alternative would take the next step toward preserving the island and regional ecological services via the conservation of approximately 350 additional acres of wetland, coastal, and nearshore habitats on Follets Island between San Luis Pass and southwest extent of Drum Bay, Texas.

Preservation of beach-to-bay habitat on Follets Island would protect the area from further development and remedy harm to a wide range of natural resources affected by the spill. Follets Island provides habitat for a diversity of wildlife, including butterflies, neo-tropical songbirds, grassland birds, raptors, waterfowl, fish species, and may other types of wildlife found in the coastal region. The island also provides nesting habitat for threatened and endangered sea turtles, as well as foraging and roosting habitat for a number of shorebirds, including the wintering piping plover and red knot, both federally threatened species. The proposed alternative would also protect the local watershed by preventing the threat of future development that would result in increased sewage discharges into Christmas Bay, which TGLO identifies as one of the main threats to this bay system (Texas TIG 2017). The goal of this proposed alternative is to prevent future development and degradation of the ecological values of the property and to maintain its current ecological services into the future. See the Follets Island Habitat Acquisition in TX TIG RP/EA #1 (Texas TIG 2017) for additional background on the historical and current conditions of the area.

Of the approximately 2,500-acre boundary of the Follets Island CMA authorized by the TPWD, approximately 1,171 acres have been acquired to date. The tracts acquired under this proposed alternative would expand upon and, in some cases, connect lands already protected, complimenting and leveraging the value of the previous and proposed acquisitions and the entire CMA.

The proposed alternative would include 1) securing the property with a purchase contract; 2) the completion of due diligence including appraisal, environmental assessment, survey, and title search; and 3) property transfer to TPWD for inclusion in the Follets Island CMA. TPWD would be the Implementing Trustee.

Passive recreation activities such as fishing from the shore and wildlife viewing would be allowed on the property. There would be clear signs to designate the appropriate use of vehicles and other activities on the land, restricting vehicles to designated roads and access easements. Under current Texas laws and regulations, the beach is a public access area open to vehicular travel. Use of the area by the public is not anticipated to be heavy; however, if necessary, TPWD could provide designated alternative pedestrian access and pedestrian trails to allow access, but in a manner designed to avoid or minimize impacts on the island habitats. Other management activities, such as the installation of bollards, could occur to preserve habitat quality. The area would also be patrolled by law enforcement professionals to enforce regulations that prevent illegal vehicular activity that could damage ecological resources. Any changes to public beach access are subject to the Texas Open Beaches Act, as administered by the TGLO.

The MAM plan for this proposed alternative is in Appendix A.

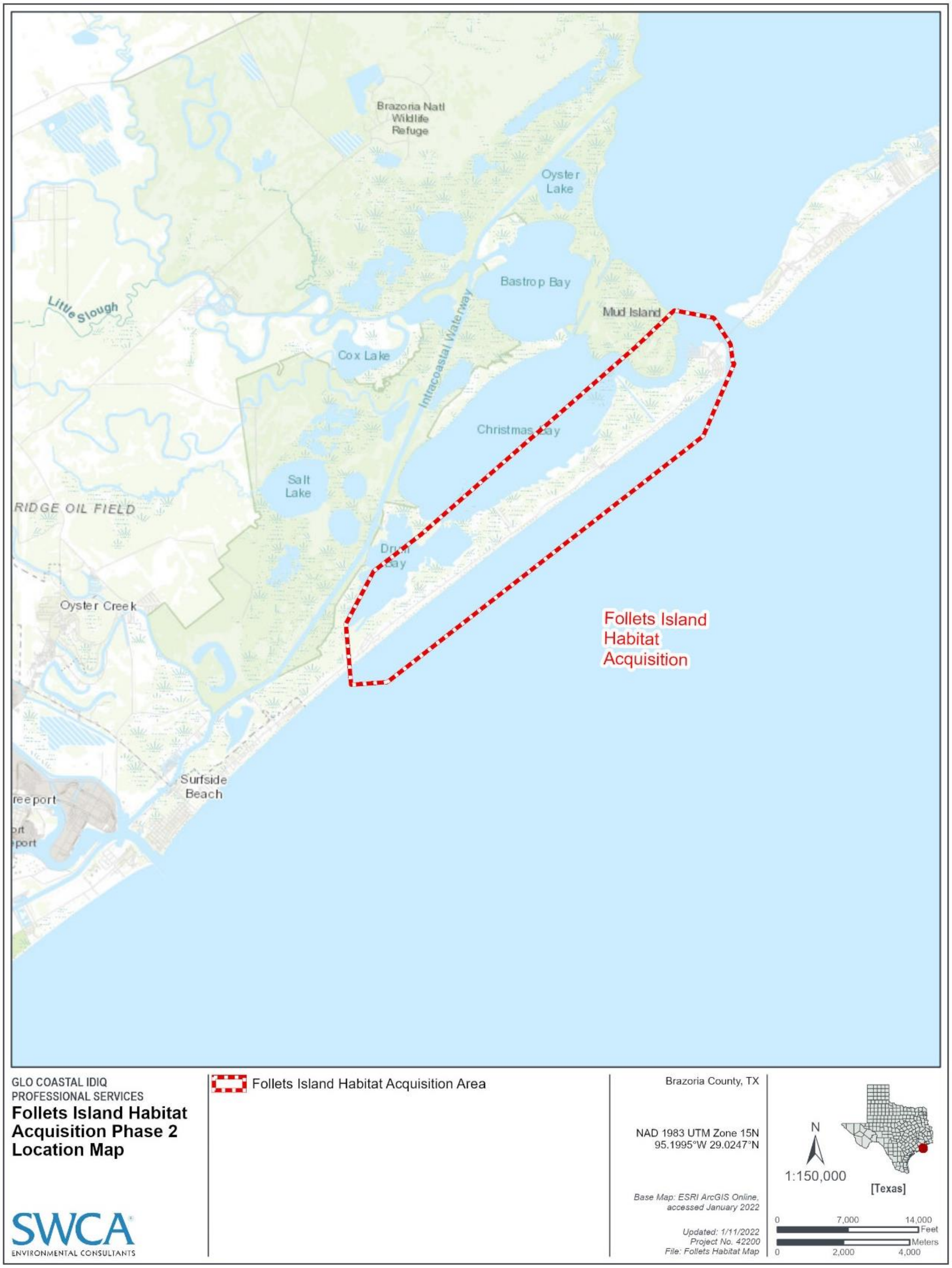

Figure 3-3. Follets Island Habitat Acquisition Phase 2 location map.

3.3.3.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Follets Island Habitat Acquisition Phase 2	**Cost-effectiveness:** The estimated cost of this proposed alternative is $3,300,000 to be funded from Wetlands, Coastal, and Nearshore Habitat restoration type dollars. The Texas TIG deemed acquisition to be a reasonable and cost-effective method to conserve and protect habitat for the Follets Island Habitat Acquisition project (Portal ID #105; https://www.gulfspillrestoration.noaa.gov/project?id=105) in the TX TIG RP/EA #1 (Texas TIG 2017). This alternative's cost is slightly more per acre than the Follets Island Habitat Acquisition in the TX TIG RP/EA #1 project. However, since the adoption of that project, this area has seen an increase in pressure by surrounding development. The Texas TIG considers the current cost to be at market rate for coastal land in this area.
	Goals and objectives: The proposed alternative would obtain and conserve approximately 350 acres of wetland, coastal, and nearshore habitats on Follets Island, which is consistent with the programmatic Trustee goal of Restore and Conserve Habitat and the Wetlands, Coastal, and Nearshore Habitats restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to injuries to coastal habitats because it would preserve habitat types (barrier islands including coastal marsh, and dune) impacted by the oil spill. The proposed alternative is also consistent with the restoration approach of protecting and conserving marine, coastal, estuarine, and riparian habitats (DWH Trustees 2016a). This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: The alternative is technically feasible, uses proven techniques with established methods and documented results and can be implemented with minimal delay. This alternative would augment existing acreage owned and managed by TPWD on Follets Island. TPWD has a proven record of successfully managing conserved coastal habitats, both generally and specifically, for Follets Island, and is well suited to continue this activity. Therefore, the proposed alternative would have a high likelihood of being successful.
	Prevents future injury and collateral injury: Aside from the potential for minor wildlife disturbances during management of the property, the proposed alternative is not expected to cause collateral injury to natural resources. The proposed alternative is an acquisition project intended to protect and conserve existing ecosystem services. Acquisition of this area would prevent future development on approximately 350 acres that could result in habitat loss or adverse effects to water quality, as well as effects to species using the habitat. Additionally, TPWD would manage the area for conservation, which would reduce the likelihood of resource impacts due to uncontrolled use of the area.
	Benefits multiple resources: Acquisition of the proposed acreage would benefit multiple resources including coastal marsh, dune habitats, water quality, and species that use those habitats (e.g., birds). This acquisition would expand permanent protection of habitats injured by the spill. The proposed alternative would protect and enhance existing habitat corridors and prevent any future development. There would also be benefits related to recreational activities such as fishing and bird watching.
	Public health and safety: Preservation of coastal habitats such as Follets Island provides public health and safety benefits as coastal marsh habitats can provide storm event protection and help support coastal resiliency for adjacent inland developed areas. Coastal marsh habitats also help improve water quality.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets Trustees goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.3.4 Galveston Island Habitat Acquisition

3.3.4.1 PROJECT DESCRIPTION

The Galveston Island Habitat Acquisition proposed alternative is located on Galveston Island adjacent to Starvation Cove and Mentzel Bayou in Galveston County, Texas (Figure 3-4). Galveston Island is a barrier island that acts as protection for coastal wetland, and nearshore habitat, and it supports a large number of bird species throughout the year by providing breeding and foraging grounds and migratory stopover habitat. This alternative proposes to contribute to the conservation of approximately 142 acres of barrier island habitat on Galveston Island, Texas, in perpetuity through a conservation easement. A total of $1,120,000 in funding would be provided under this proposed alternative to help cover land acquisition costs; remaining funding for the total estimated project cost of $6,120,000 would come from other potential sources. If selected by the Texas TIG in the Final RP/EA #2, this alternative would only be implemented if funding through other sources is allocated so that the entire 142-acre tract and conservation easement could be acquired.

The 142-acre property is currently planned for residential commercial development. Acquisition of the property would preserve its coastal resiliency benefits by preventing the development and associated degradation of this portion of the barrier island's natural resources. Additionally, continued monitoring of the property by the conservation easement holder would ensure that ecological services provided by the habitat on the property are protected and maintained.

This proposed alternative would include 1) the completion of due diligence including appraisal, land surveys, title searches, and an Environmental Site Assessment (ESA) Phase I audit; 2) realty closing and associated signatures, and transferring ownership to an external partner, Artist Boat (a local nonprofit organization whose mission is to promote awareness and preservation of coastal margins and the marine environment, and which has successfully conserved over 600 acres on west Galveston Island [Artist Boat 2021]); and 3) continued monitoring in accordance with an approved MAM plan. In addition, a conservation easement would be held by a certified land trust organization. The TCEQ would be the Implementing Trustee and would work with project partners consisting of TPWD, Galveston Bay Estuary Program, and the USFWS. Successful implementation of the alternative would be determined upon transfer of the property to Artist Boat and the placement of a conservation easement on the property.

The property would be preserved in perpetuity through a conservation easement held by an approved easement holder and added to an approximate 1,250-acre conservation network of adjacent properties with Trustees having third-party rights of enforcement. Signs would be installed and maintained that indicate that the site is under conservation stewardship and has controlled public access. Under current Texas laws and regulations, the public has access to state-owned submerged lands. Any changes to these laws and regulations are subject the public's right to access state waters under Texas law.

The MAM plan for this proposed alternative is attached in Appendix A.

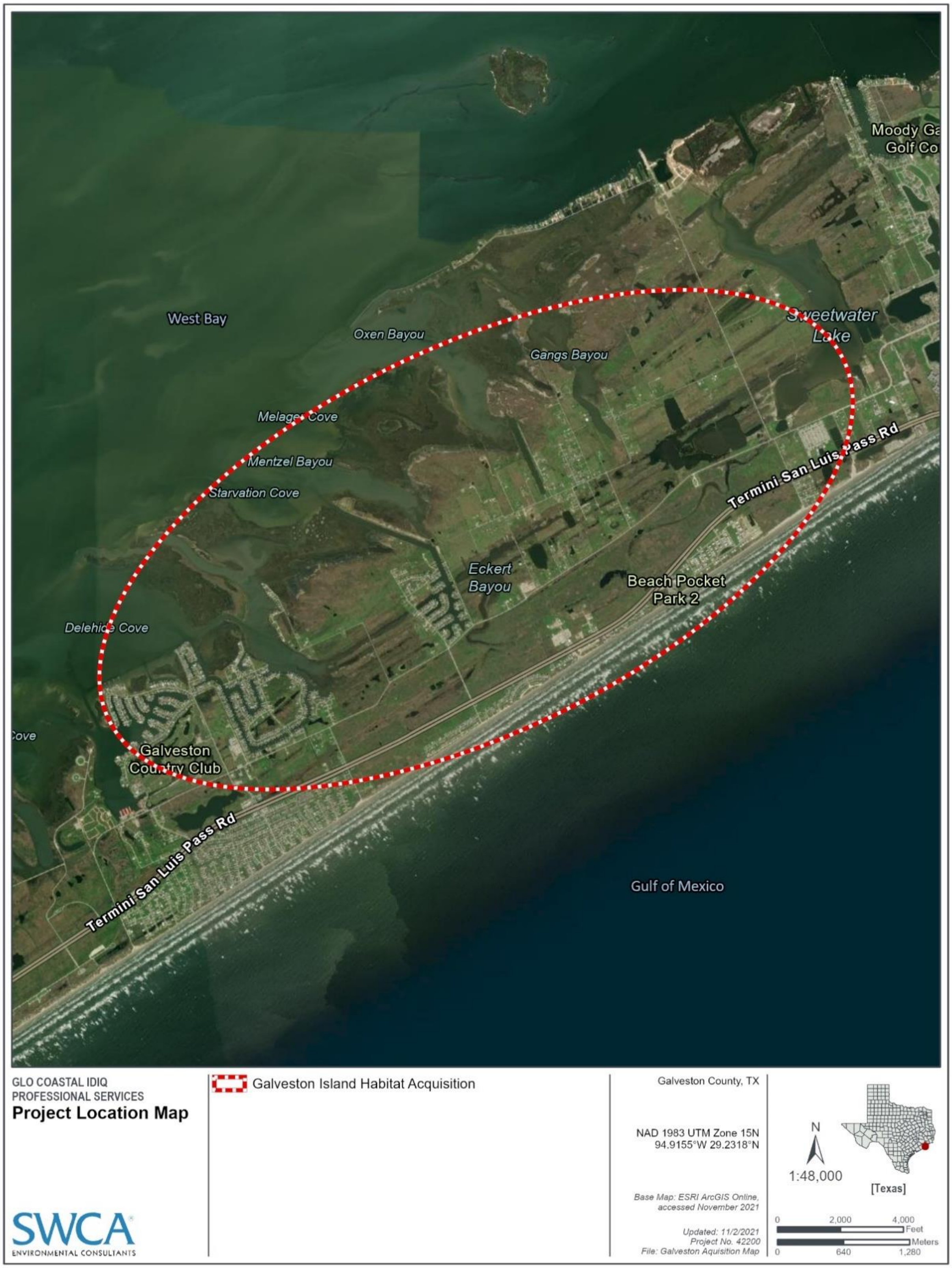

Figure 3-4. Galveston Island Habitat Acquisition location map.

3.3.4.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Galveston Island Habitat Acquisition	**Cost-effectiveness:** The estimated cost of this proposed alternative is $1,120,000 to be funded from Wetlands, Coastal, and Nearshore Habitat restoration type dollars. This amount, combined with additional funding from other sources, would be used to fund the total estimated cost of $6,120,000. The tract is located in a highly developed coastal location in a very competitive real estate market. Because this area is under consideration for development in an area already pressured by surrounding development, the cost per acre is higher than areas that are more rural and more difficult to access, but, overall, the market rate is appropriate for coastal land on the bay side of Galveston Island. Therefore, the Texas TIG has deemed the cost reasonable and appropriate. This alternative is also cost effective because it leverages other sources of funds and would only be implemented if sufficient funding is allocated so that the entire 142-acre tract and conservation easement could be acquired.
	Goals and objectives: The proposed alternative would contribute to the conservation of approximately 142 acres of barrier island habitat, which is consistent with the programmatic Trustee goal of Restore and Conserve Habitat and the Wetlands, Coastal, and Nearshore Habitats restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to injuries to coastal habitats and is consistent with the restoration approach of protecting and conserving marine, coastal, estuarine, and riparian habitats (DWH Trustees 2016a) and associated ecosystem services. This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative is technically feasible and uses proven techniques with established methods and documented results. This alternative would augment an approximately 1,250-acre conservation network of adjacent properties where Trustees have third-party rights of enforcement. The Texas TIG has a proven record of successfully implementing habitat acquisition projects and forming partnerships to manage the areas placed under a conservation easement. The proposed alternative would have a high likelihood of being successful if the additional funding necessary for acquisition is secured.
	Prevents future injury and collateral injury: The proposed alternative would avoid and minimize collateral injury because it is an acquisition project intended to protect and conserve existing ecosystem services. Acquisition of this area would prevent imminent development of 142 acres that would result in loss of or adverse effects to habitats, as well as effects to species using the habitat. Additionally, the area would be managed for conservation, which would reduce the likelihood of unauthorized public access.
	Benefits multiple resources: Acquisition of the proposed acreage would benefit multiple resources including coastal marsh and estuarine habitats, as well as species that use those habitats (e.g., fish and birds). This acquisition would expand permanent protection of habitats injured as a result of the spill. The proposed alternative would protect and add to an existing protected habitat corridor and prevent future development. There would also be benefits related to recreational activities such as bird watching.
	Public health and safety: Preservation of coastal habitats provides public health and safety benefits as coastal marsh habitats can provide storm event protection and help support coastal resiliency for adjacent inland developed areas. Coastal marsh habitats also help improve water quality. The preservation of natural habitat would also help improve coastal resiliency.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets Trustees goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.3.5 Matagorda Peninsula Habitat Acquisition

3.3.5.1 PROJECT DESCRIPTION

The Matagorda Peninsula Habitat Acquisition proposed alternative is located on the Matagorda Peninsula in Matagorda County, Texas (Figure 3-5). The Matagorda Peninsula is a barrier island system that separates the East Matagorda Bay from the Gulf of Mexico. This alternative proposes to obtain and conserve 400 acres of wetland, coastal, and nearshore habitats on the Matagorda Peninsula east of the Colorado River, Texas, in perpetuity through fee-simple acquisition for inclusion to the existing Matagorda Peninsula CMA. The estimated total cost of this proposed alternative is $1,300,000.

The Matagorda Peninsula contains a diversity of coastal wildlife from nesting sea turtles to resident and migratory shore and wading birds, several of which are listed as species of greatest conservation need. Habitat present on the peninsula consists of Gulf beaches, sand dunes, lagoons, strand prairies, bayous, tidal flats, and emergent salt marshes that are critical to produce crustaceans, shellfish, and finfish. In 2017, TPWD established the Matagorda Peninsula CMA with the acquisition of 5,402 acres on Matagorda Peninsula, preserving 12 miles of peninsula from the Caney Creek Cut westward and from the Gulf of Mexico to East Matagorda Bay. In 2020, TPWD acquired two tracts of land encompassing 962 acres with 1.4 miles of beach for addition to the Matagorda Peninsula CMA. Continued preservation of the habitat on Matagorda Peninsula would protect the area from further development and benefit multiple biological resources such as sea turtles and shorebirds. This alternative would also benefit flora and fauna by protecting existing habitat corridors by enlarging the amount of protected habitat adjacent to East Matagorda Bay. See the Matagorda Peninsula Habitat Acquisition project in the TX TIG RP/EA #1 (Texas TIG 2017) for additional background on the historical and current conditions of the area.

This alternative would include 1) the completion of due diligence including appraisal, environmental assessment, survey and title search; 2) securing the property with a purchase contract; and 3) property transfer to TPWD for inclusion in the Matagorda Peninsula CMA. TPWD would be the Implementing Trustee.

Passive recreation activities such as fishing from the shore and wildlife viewing would be allowed on the property. There would be clear signs to designate the appropriate use of vehicles and other activities on the land, restricting vehicles to appropriate designated roads and access easements. Under current Texas laws and regulations, the beach is a public access area open to vehicular travel. Use of the area by the public is not anticipated to be heavy; however, if necessary, TPWD could provide designated alternative pedestrian access and pedestrian trails to allow access but in a manner designed to avoid or minimize impacts on the island habitats. Other management activities such as the installation of bollards could occur to preserve habitat quality. The area would also be patrolled by law enforcement professionals to enforce regulations that prevent illegal vehicular activity that could damage ecological resources. Any changes to public beach access are subject to the Texas Open Beaches Act, as administered by the TGLO.

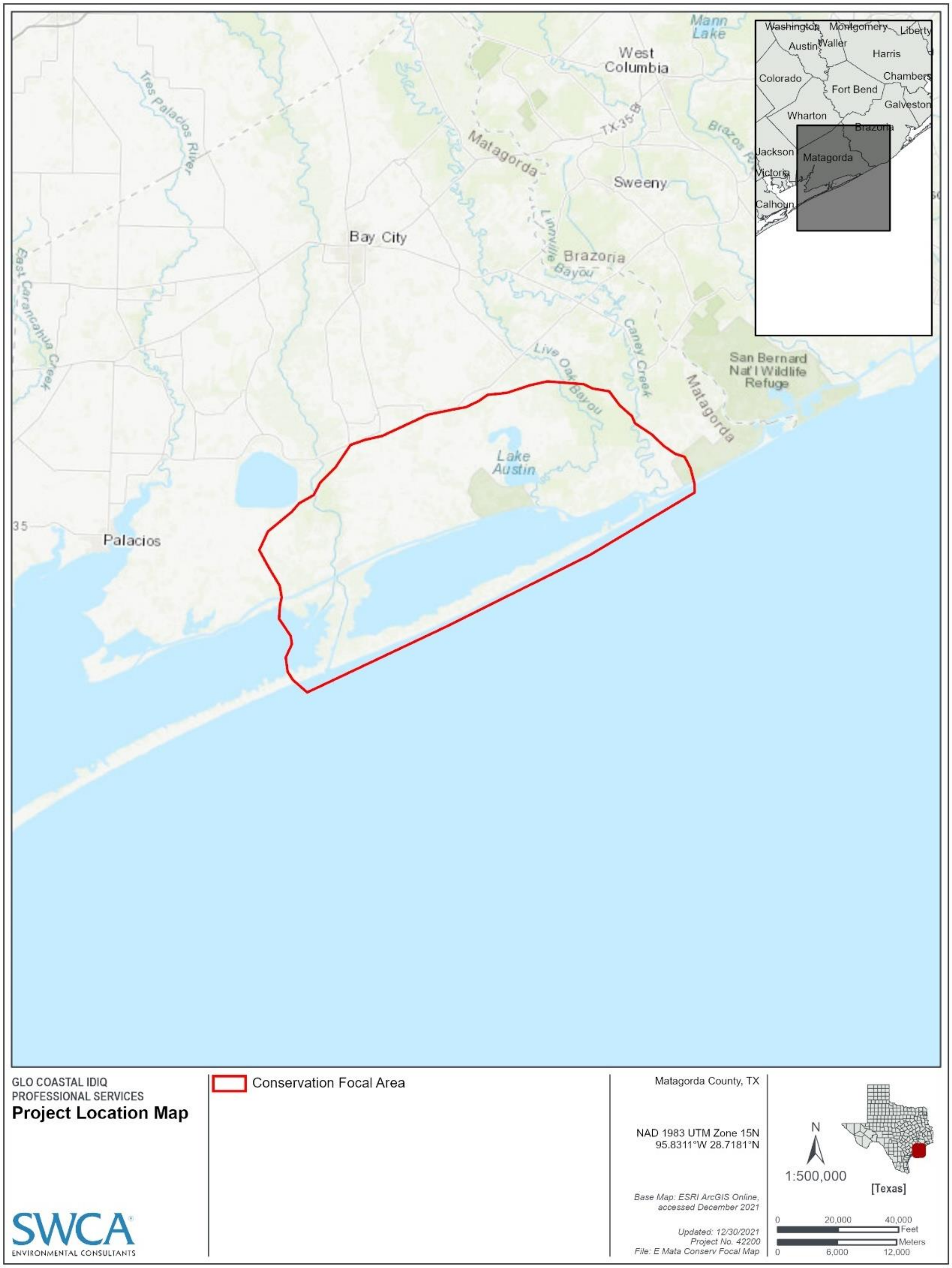

Figure 3-5. Matagorda Peninsula location map.

3.3.5.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Matagorda Peninsula Habitat Acquisition	**Cost-effectiveness:** The estimated cost of this proposed alternative is $1,300,000 to be funded from Wetlands, Coastal, and Nearshore Habitat restoration type dollars. The Texas TIG deemed acquisition to be a reasonable and cost-effective method to conserve and protect habitat for the Matagorda Peninsula Habitat Acquisition project in the TX TIG RP/EA #1 (Texas TIG 2017). However, due the lack of imminent development pressure, this alternative is not presently as cost effective as other acquisition alternatives considered in the RP/EA #2.
	Goals and objectives: The proposed alternative would obtain and conserve 400 acres of wetland, coastal, and nearshore habitats on the Matagorda Peninsula, which is consistent with the programmatic Trustee goal of Restore and Conserve Habitat and the Wetlands, Coastal, and Nearshore Habitats restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to injuries to coastal habitats and is consistent with the restoration approach of protecting and conserving marine, coastal, estuarine, and riparian habitats (DWH Trustees 2016a) and would enhance the ecosystem services they provide. This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative is technically feasible and uses proven techniques with established methods and documented results. TPWD has proven experience acquiring and protecting coastal habitats. Additionally, there is a CMA on Matagorda Island in which TPWD is actively managing conservation lands. Therefore, the proposed alternative would have a high likelihood of success.
	Prevents future injury and avoids collateral injury: Aside from the potential for minor wildlife disturbances during management of the property, the proposed alternative is not expected to cause collateral injury to natural resources. The proposed alternative is an acquisition project intended to protect and conserve existing ecosystem services. Additionally, it would prevent future development that could result in habitat loss or adverse effects, as well as effects to species using the habitat. Additionally, TPWD would manage the area for conservation, which would reduce likelihood of resource impacts due to unauthorized public access.
	Benefits multiple resources: Acquisition of the proposed acreage would benefit multiple resources including coastal marsh, and dune habitats, water quality, as well as species that use those habitats (e.g., sea turtles and nesting and other birds). This acquisition would expand permanent protection of habitats injured by the spill. The proposed alternative would protect and enhance existing habitat corridors and prevent any future development. There would also be benefits related to recreational activities such as fishing and bird watching. However, the scale of benefits received would be lower than other alternatives in this document because the threat of imminent development is lower.
	Public health and safety: Preservation of coastal habitats such as the Matagorda Peninsula provides public health and safety benefits as coastal marsh habitats can provide storm event protection and help support coastal resiliency for adjacent inland developed areas. Coastal marsh habitats also help improve water quality. The preservation of natural habitat would also help improve coastal resiliency.
	Summary: Based on the OPA analysis, this alternative is not identified as a preferred alternative at this time in the RP/EA #2. Although the alternative has a reasonable cost per acre of land, the benefits to resources received would not be as great as other projects proposed in this document, and therefore the cost-effectiveness is lower compared to other evaluated acquisition alternatives. Additionally, the alternative does not meet Trustee goals and objectives as there is no reasonable imminent threat of development. However, this alternative has a high probability of success, prevents future injury and avoids collateral injury and would benefit public health and safety.

3.4 OPA NRDA Evaluation of Nutrient Reduction (Nonpoint Source) Alternatives

3.4.1 Petronila Creek Constructed Wetlands Planning

3.4.1.1 PROJECT DESCRIPTION

The Petronila Creek Constructed Wetlands Planning proposed alternative is located on a 240-acre tract adjacent to Petronila Creek, approximately 17 river miles upstream of Baffin Bay, and downstream of more than 200,000 acres of cultivated land in a heavily farmed watershed (Figure 3-6). The Texas TIG's restoration planning work for the nutrient reduction restoration type (Parsons 2019) identified three target watersheds and further narrowed this area to a group of nine 12-digit hydrologic unit codes (HUCs) designated as Tier 1 (highest priority) watersheds. These nine Tier 1 watersheds were targeted for nonpoint source reduction strategies. This alternative would include a feasibility study and, if determined to be feasible, development of 30% E&D, permitting components, and completion of the planning stages necessary to convert a 240-acre agricultural tract into constructed wetlands through which Petronila Creek would be diverted. The site is ideally suited within the watershed to intercept and treat nutrient-rich agricultural runoff, thereby reducing water quality impacts to Baffin Bay. Water would be drawn from Petronila Creek and passed through the wetlands for water quality improvements before being returned to the creek. The goal of the alternative would be to design a treatment wetland that would treat up to 15,000 acre-feet of water per year. The estimated total cost of this proposed alternative is $450,000.

Petronila Creek is a 44-mile freshwater stream spanning Kleberg and Nueces Counties, located within the Nueces-Rio Grande Coastal Basin. The Nueces-Rio Grande Coastal Basin has a drainage area of approximately 10,442 square miles. Petronila Creek drains approximately 543 square miles of this basin and is part of the Baffin Bay watershed. It is formed by the confluence of Agua Dulce and Banquete Creeks one mile southeast of the town of Banquete in western Nueces County, and is located southwest of the city of Corpus Christi, Texas. Petronila Creek is fed by several tributaries that serve as drainage ditches for agricultural cropland. Petronila Creek is one of the three major tributaries to Baffin Bay.

Petronila Creek was identified as having the greatest opportunity for implementing nonpoint source nutrient reduction strategies because modeling of nutrient loads confirmed that nonpoint sources associated with pasture/grassland and cropland (e.g., land application of livestock manure and/or commercial fertilizer, wildlife populations, feral hog populations, livestock grazing, and hunting camps) in the Petronila Creek watershed are the primary contributors to nutrient loads (Parsons 2019). Studies of Baffin Bay also indicate periodic poor water quality, including high algal activity and periods of harmful algal blooms (brown tide) that occur as a result of both natural geometry factors (depth, inflows, tides) and high nutrient levels (Stanzel 2020).

Land use within the Petronila Creek watershed is largely agricultural and is used for cropland and grazing. Nutrient runoff from agricultural lands can adversely affect the health of coastal waters. Excessive nutrient enrichment, or eutrophication, of Gulf Coast estuaries and their watersheds is a chronic threat that can lead to hypoxia (low oxygen levels), harmful algal blooms, habitat loss, and fish kills (NOAA 2021c). Oil and gas development has contributed to water quality impairments in Petronila Creek (Above Tidal [Segment 2204]), which has been impaired for chloride, sulfates, and total dissolved solids (TDS) since 1999 (TCEQ 2010). Total maximum daily loads (TMDLs) under the Clean Water Act (CWA) establish the maximum amount of a pollutant allowed in a waterbody and serves as the starting point or planning tool for restoring water quality. TMDLs for chloride, sulfate, and TDS (which is inclusive of nutrient loads) for Petronila Creek were approved in 2007 (TCEQ 2007a). In 2008, a Railroad Commission of Texas (RRC) report concluded that oil and gas wasteland fields and other unknown sources were contributing chlorides to Petronila Creek through groundwater (RRC 2008). As a result of the TMDL implementation plan, soils of high chloride content were identified and removed, a continuous water quality monitoring station was installed and is still being monitored, and groundwater-to-surface water interactions were studied (TCEQ 2014). In addition, Petronila Creek (Tidal [Segment 2203]) has been listed as impaired for bacteria (not supporting primary contact recreation use) since 2010. The segment also has screening level concerns for pH, total phosphorus, and chlorophyll-a (TCEQ 2010).

The TGLO would be the Implementing Trustee and would work with project partners consisting of the Coastal Bend Bays and Estuaries Program (CBBEP) and the landowner.

Before conducting E&D, during planning activities, an engineering firm would evaluate project feasibility for nutrient reduction potential and estimate costs of a construction proposal. The evaluation would include:

- modeling to assess the efficacy of nutrient reduction and other water quality improvements from implementation of the project;
- determining the feasibility of obtaining permits, including the need and potential for obtaining a water use permit;
- evaluating the cost of the estimates in the proposal;
- performing appropriate environmental compliance reviews;
- developing a long-term management plan, including a conservation easement and long-term stewardship strategy and associated costs to ensure perpetual maintenance;
- planning to include site topography, hydrology, soil characteristics, plant selection, and other project-specific and site-specific variables; and
- creating a conceptual postconstruction MAM plan to quantify impacts to nutrient and sediment loads and the water quality health of Petronila Creek.

If the Texas TIG determines the proposal feasible based on the items listed above, the engineering firm would then prepare a 30% design, including drawings, specifications, construction schedule, and an opinion of probable construction costs, and submit permit applications. If not determined feasible, remaining funds would be returned for use by nutrient reduction projects in other restoration plans.

The alternative would include design of a series of wetlands and wet ponds as a comprehensive ecosystem design. Design would take into consideration forebays and sediment traps, as well as deeper pools for sediment accumulation to reduce maintenance and volume loss over time. A secondary benefit of the alternative includes a design that can support preservation of existing riparian habitats. Due to variable salinity levels in Petronila Creek, a range of natural wetland areas could be incorporated into the design, including tidal salt marsh, brackish and intermediate marsh, and non-tidal freshwater marsh. The design could also address whether soils from the constructed channels, wetlands, and pond excavations may remain on-site and be used to create higher ground to further modify the site and retain water.

The design would incorporate biomimicry; human-made replications of natural processes; and natural processes involving wetland vegetation, soils, and their associated microbial assemblages to decrease nitrogen, phosphorus, and sediment pollutant loads to Petronila Creek and the Baffin Bay watershed.

No monitoring is proposed for this alternative as it only encompasses a feasibility study, E&D, and permitting, which would determine feasibility of potential future construction actions. A future project building from this proposed E&D project may be proposed and considered for funding in a future restoration plan.

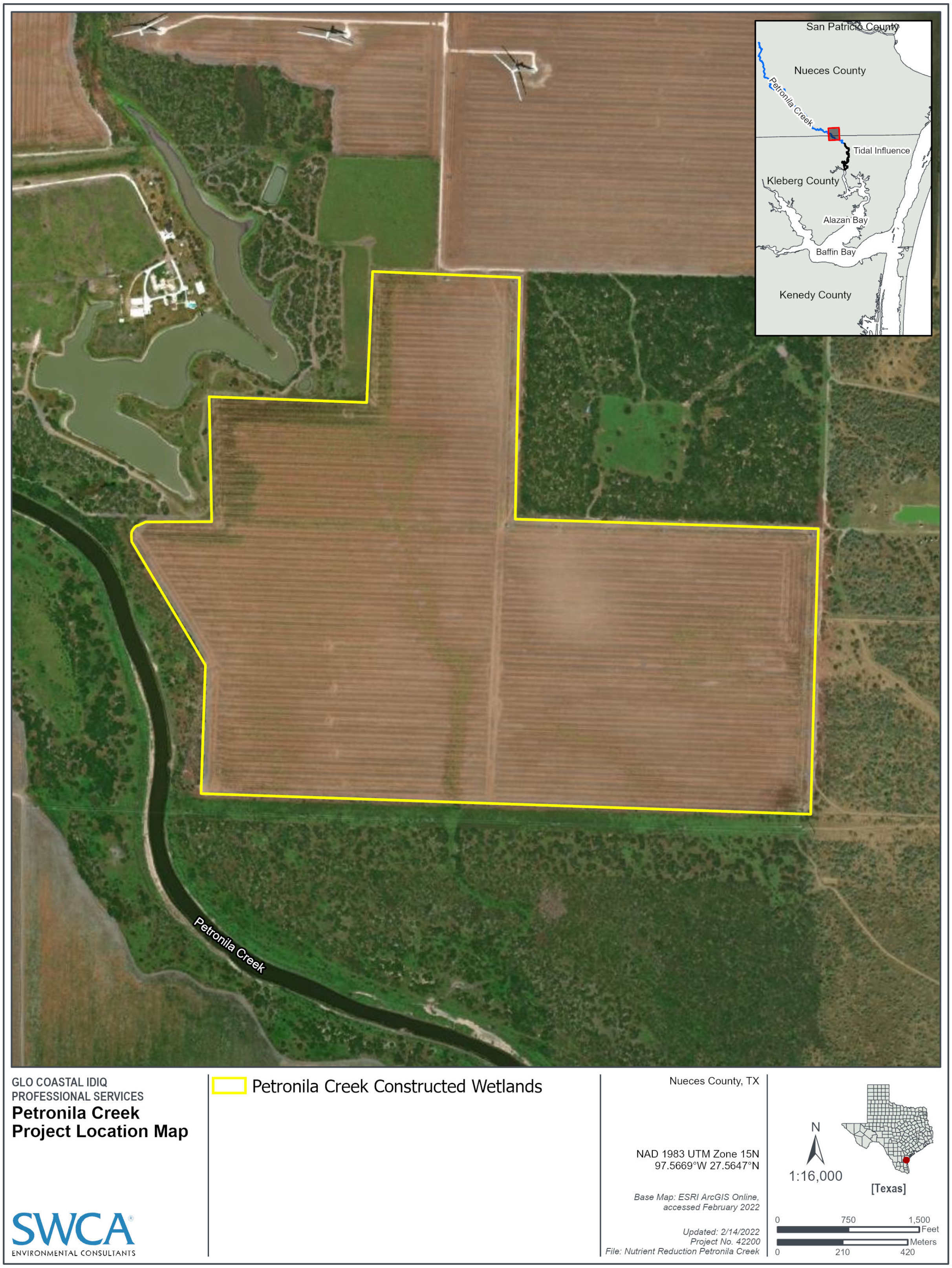

Figure 3-6. Petronila Creek Constructed Wetlands location map.

3.4.1.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Petronila Creek Constructed Wetlands (E&D)	**Cost-effectiveness:** The estimated cost of this proposed alternative is $450,000 to be funded from Nutrient Reduction restoration type dollars. The alternative is cost effective because it would prioritize funds on first assessing constructed wetland feasibility and, to the extent that it is feasible, implement restoration approaches that can provide significant reductions in nutrient levels, based on preliminary findings from Texas A&M University's Soil & Water Assessment Tool and other similar constructed wetland projects (e.g., George W. Shannon Wetlands Project). Total costs represent best estimates consistent with previous E&D costs for prior projects, such as the Toulmins Spring Branch (E&D) project in Alabama TIG's RP/EA #2 (Portal ID #164; https://www.gulfspillrestoration.noaa.gov/project?id=164).
	Goals and objectives: While a feasibility analysis and E&D is not a direct benefit to any specific goal or objective, they would help the Texas TIG determine whether an alternative would effectively address nutrient reduction and can be used to enhance the quality of a future project by creating a design that would maximize the reduction of nutrient runoff into coastal watersheds. The goal of the proposed E&D activities would be to help ensure the success of the project if it is eventually selected for construction. If constructed, the proposed alternative would be consistent with the programmatic Trustee goal of Restore Water Quality and the Nutrient Reduction restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to the injuries from the oil spill by reducing nitrogen, phosphorus, and sediment pollutant loads to Gulf of Mexico coastal watersheds. This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: E&D is likely to be successful as it involves standard and proven planning activities, including but not limited to field surveys, geotechnical investigations, and hydrologic modeling. Conducting E&D activities reduces the uncertainties for the construction phase to ensure the project could be constructed to maximize its likelihood of success. The proposed alternative would provide the necessary feasibility determination, design details, and management plan for development of a successful construction project in the future. In addition, it would focus on developing strategies to establish long-term protection through development of a long-term management plan to increase the likelihood of future success. The Texas TIG selected this alternative for potential E&D investment to ensure that the alternative, if constructed, could be done in a manner that would maximize its likelihood of success.
	Prevents future injury and avoids collateral injury: Determining the feasibility and conducting E&D of the proposed constructed wetland would not impact natural resources. There are no pilot studies proposed for this alternative that could result in collateral injuries. The E&D would also enhance the ability of the Texas TIG to ensure that any impacts from a possible future project would be minimized at the earliest stage possible.
	Benefits multiple resources: Determining the feasibility and conducting E&D of the proposed constructed wetland would not directly result in resource benefits. However, if proposed and funded for construction, that alternative could benefit multiple resources due to future reductions in nutrient losses from the landscape and the resulting reductions in nutrient loads to streams and downstream receiving waters; this would provide benefits to recreational users as well as varied coastal and marine resources. E&D would develop the proposed alternative with these benefits in mind.
	Public health and safety: Activities proposed for E&D and planning would have no effect on public health and safety.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost of the feasibility study and E&D work is reasonable, the preliminary work will ensure a high probability of success, the alternative meets Trustees goals and objectives, and no impacts to natural resources or public health and safety are associated with E&D work.

3.4.2 Petronila Creek Watershed Nutrient Reduction Initiative

3.4.2.1 PROJECT DESCRIPTION

The Texas TIG's restoration planning work for the nutrient reduction restoration type (Parsons 2019) identified three target watersheds, and further narrowed this area to a group of nine 12-digit HUCs designated as Tier 1 (highest priority) watersheds. These nine Tier 1 watersheds were targeted for nonpoint source reduction strategies. The Petronila Creek Watershed Nutrient Reduction Initiative proposed alternative is located in three of these nine Tier 1 watersheds: City of Concordia-Petronila Creek, Gertrude Lubby Lake-Petronila Creek, and Chapman Ranch Lake-Petronila Creek (Figure 3-7).

The alternative proposes to implement conservation practices on agricultural lands within the boundaries of three 12-digit HUC watersheds[4] to improve water quality conditions at the watershed level. Outreach and financial and technical assistance would be provided to voluntary participants to develop and implement conservation practices on agricultural land that is vulnerable to nutrient and sediment runoff. The estimated total cost of this proposed alternative is $4,300,000.

Within the Tier 1 watersheds, cropland is the primary land use, representing 95% of the total watershed area. Nutrient runoff from agricultural lands can adversely affect the health of coastal waters. Excessive nutrient enrichment, or eutrophication, of Gulf Coast estuaries and their watersheds is a chronic threat that can lead to hypoxia (low oxygen levels), harmful algal blooms, habitat loss, and fish kills (NOAA 2021c). This alternative would restore and enhance the ecological and hydrological integrity of water resources within three immediate tributaries and receiving waterbodies. The alternative would implement conservation practices to reduce nutrient and sediment runoff from agricultural lands within the greater Baffin Bay - Petronila Creek watershed. Although agricultural lands are not the sole contributors of nutrients to coastal waters, they are a major contributor. Reducing nutrient and sediment loads to the system would improve the functionality of in-stream habitats used by aquatic organisms to fulfill critical life history cycles.

Conservation practices would be designed to reduce erosion, slow runoff velocities, and increase hydraulic residence time within the field or tract, and/or edge of field, all of which are imperative to the physical, chemical, and biological processes that decrease nutrient and sediment loadings (Barlow and Kröger 2014). These conservation practices would be targeted in small areas to produce measurable decreases in nutrients and sediments from the agricultural fields, as well as within the downstream receiving water body.

This alternative would include 1) landowner outreach and education, 2) conservation planning, 3) E&D and environmental compliance, and 4) conservation practice implementation. The USDA would be the Implementing Trustee and anticipates working with potential project partners, including landowners. The landowners would be responsible for maintenance and operation of structural measures and application of non-structural measures.

Initial activities would include landowner outreach and education. Landowners within the watersheds would be solicited to implement nutrient reduction best management practices on private lands. Outreach and technical assistance would be provided to voluntary participants on agricultural lands that are most vulnerable to nutrient and sediment runoff. This includes providing financial assistance to landowners to acquire soil samples, site-specific analyses, and nutrient application methods. Site-specific environmental evaluations would be conducted and documented, as described in greater detail in Section 4.3.2 of the RP/EA #2. A site-specific conservation plan would be developed in cooperation with individual landowners. Implementation of conservation practices would include implementation of structural practices (e.g., earth moving) and non-structural practices (e.g., nutrient management). Engineering plans and designs for structural practices would be included in the conservation plans and funding would help landowners acquire all local, state, and federal permits required to implement the conservation practice(s).

[4] Twelve-digit HUC watersheds are delineated by USGS. As stated by USGS, "A complete list of Hydrologic Unit codes, descriptions, names, and drainage areas can be found in the United States Geological Survey Water-Supply Paper 2294, entitled *Hydrologic Unit Maps*."

Contracts with landowners would serve as an agreement to implement the conservation practices on their properties as outlined in a conservation plan developed according to appropriate standards and specifications (including any required property access agreement and activities related to project monitoring). Although the landowner would typically implement the conservation practices, if the landowner is not capable of carrying out the work, a third party could be hired to implement them. Operation and maintenance would be evaluated as specified in the conservation plan and may include, but would not be limited to, addressing soil erosion or vegetation establishment issues due to weather-related events. Operation and maintenance activities would be identified in the conservation plan based on site evaluations and performance monitoring data and reports.

The MAM plan for this proposed alternative is in Appendix A.

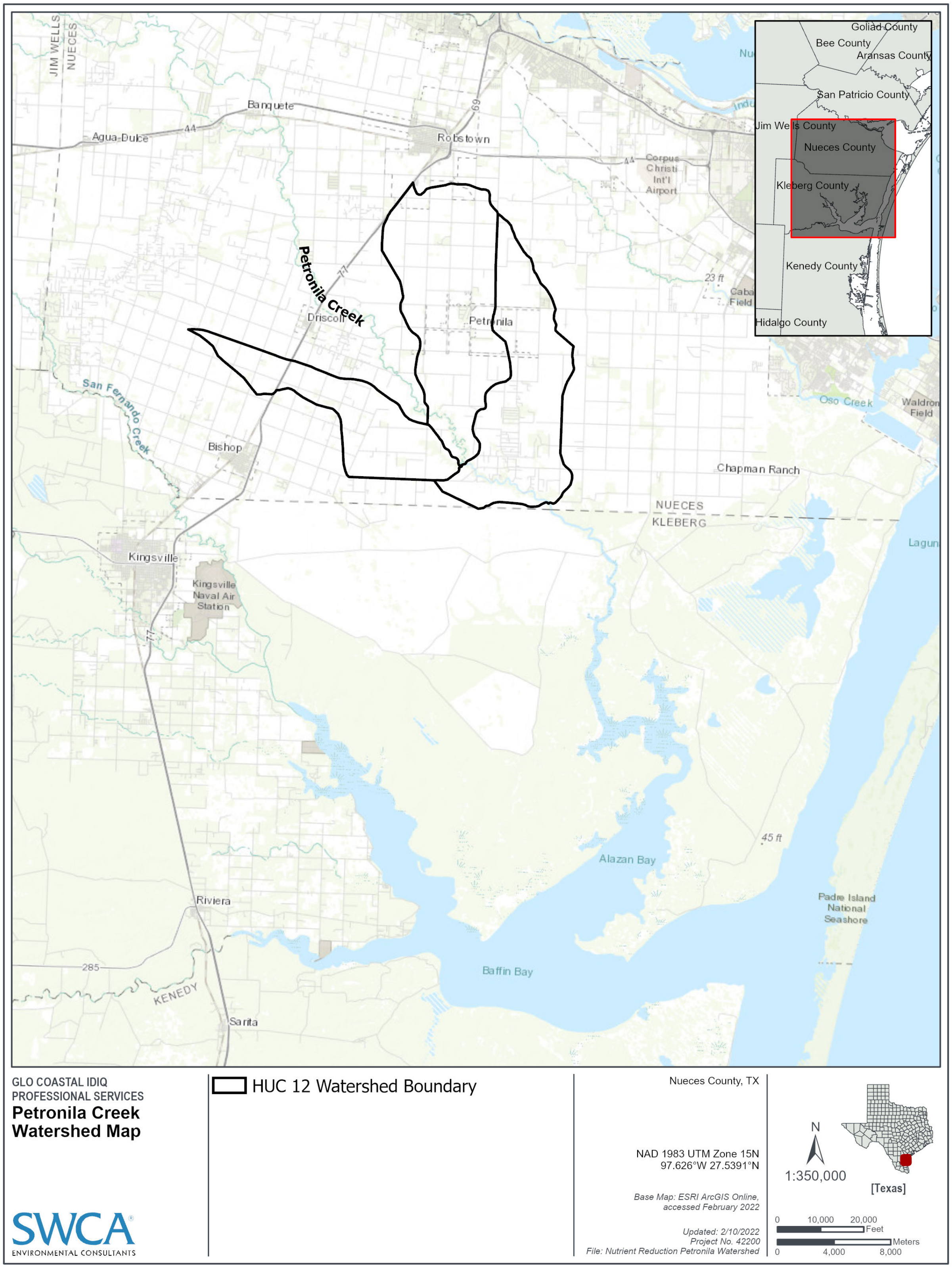

Figure 3-7. Petronila Creek Watershed location map.

3.4.2.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Petronila Creek Watershed Nutrient Reduction Initiative	**Cost-effectiveness:** The estimated cost of this proposed alternative is $4,300,000 to be funded from Nutrient Reduction restoration type dollars. The restoration approaches proposed by the USDA have been applied extensively across the country, and the costs are well documented and reasonable (USDA 2014) to cost-effectively reduce nutrient loads. Proposed alternative costs are also consistent with prior nutrient reduction projects implemented as part of restoration planning in Alabama, Louisiana, Mississippi, and Florida., such as the following: • Alabama: Toulmins Spring Branch (E&D) project (Portal ID #164; https://www.gulfspillrestoration.noaa.gov/project?id=164); Fowl River Nutrient Reduction (Portal ID# 165; https://www.gulfspillrestoration.noaa.gov/project?id=165); and Weeks Bay Nutrient Reduction (Portal ID# 166; https://www.gulfspillrestoration.noaa.gov/project?id=166) • Florida: St. Marks National Wildlife Refuge Coastal Trail Connection, Spring Creek to Port Leon (Portal ID #207; https://www.gulfspillrestoration.noaa.gov/project?id=207); Pensacola Bay and Perdido River Watersheds - Nutrient Reduction (Portal ID #208; https://www.gulfspillrestoration.noaa.gov/project?id=208); and Lower Suwannee River Watershed - Nutrient Reduction (Portal ID #209; https://www.gulfspillrestoration.noaa.gov/project?id=209) • Mississippi: Upper Pascagoula Water Quality Enhancement Project (Portal ID #96; https://www.gulfspillrestoration.noaa.gov/project?id=96) • Louisiana: Nutrient Reduction on Dairy Farms in St. Helena and Tangipahoa Parishes (Portal ID #167; https://www.gulfspillrestoration.noaa.gov/project?id=167); Nutrient Reduction on Dairy Farms in Washington Parish (Portal ID #168; https://www.gulfspillrestoration.noaa.gov/project?id=168); Nutrient Reduction on Cropland and Grazing Land in Bayou Folse (Portal ID #169; https://www.gulfspillrestoration.noaa.gov/project?id=169); and Winter Water Holding on Cropland in Vermilion and Cameron Parishes Plus Agricultural BMP (Portal ID #170; https://www.gulfspillrestoration.noaa.gov/project?id=170)
	Goals and objectives: The proposed alternative would implement conservation practices on agricultural lands to improve water quality conditions and reduce nutrient loadings and is therefore consistent with the programmatic Trustee goal of Restore Water Quality and the Nutrient Reduction restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to the injuries from the oil spill by reducing nitrogen, phosphorus, and sediment pollutant loads to Gulf of Mexico coastal watersheds. The health of the Gulf of Mexico depends upon the health of its estuaries, and the health of those coastal waters is influenced by land use upstream along tributary rivers. This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: Given the USDA's expertise, the success and legacy of USDA conservation programs, and the agency's established level of trust and cooperation with private landowners, there is a reasonable likelihood that the USDA could successfully implement the proposed alternative to reduce the levels of nutrients entering watersheds. Proposed conservation practices have been well demonstrated to reduce nutrient loads and are appropriate for agricultural lands. This proposed alternative also includes elements that enhance the likelihood of success, including 1) landowner outreach and education, and 2) the use of landowner contracts and site-specific conservation plans.
	Prevents future injury and avoids collateral injury: Implementation of conservation practices (both structural practices [e.g., earth moving] and non-structural practices [e.g., nutrient management]) could result in a minor loss of coastal habitat, as well as associated noise and human activity, but all impacts would be temporary. Site-specific conservation plans would include BMPs for landowner operations and maintenance of conservation practices to avoid or minimize collateral injury to natural resources. The USDA would also conduct site evaluations and review monitoring data to ensure all implemented practices meet conservation practice standards. Further, the implementation of conservation practices would ultimately contribute to healthier and more resilient downstream coastal ecosystems that were injured by the DWH oil spill.
	Benefits multiple resources: The proposed alternative could benefit multiple resources due to future reductions in nutrient runoff and the resulting reductions in nutrient loads to streams and downstream receiving waters; this would provide benefits to recreational users as well as varied coastal and marine resources.
	Public health and safety: The proposed alternative, if implemented, would result in beneficial impacts to water quality in the watershed, which reduces risks to public health and safety. The implementation of conservation practices would not introduce any new risks for agricultural workers or pose threats to air or water quality.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success; the alternative meets Trustees goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.4.3 Petronila Creek Crooked Ditch Restoration

3.4.3.1 PROJECT DESCRIPTION

The Petronila Creek Crooked Ditch Restoration proposed alternative (Crooked Ditch) is a 7.6-mile-long channelized waterway located within the Luby Oil Field near Chapman Ranch in Nueces County, extending from County Road 20 south to Petronila Creek, bypassing the Cefe Valenzuela Landfill and agricultural fields (Figure 3-8). The alternative proposes to convert a portion of the channelized ditch back into a meandering flow-way with a vegetated buffer in order to reduce nutrient loading and erosion. The estimated total cost of this proposed alternative is $6,500,000.

The Texas TIG's restoration planning work for the nutrient reduction restoration type (Parsons 2019) identified three target watersheds, and further narrowed this area to a group of nine 12-digit HUCs designated as Tier 1 (highest priority) watersheds. These nine Tier 1 watersheds were targeted for nonpoint source reduction strategies. Crooked Ditch is located within a Tier 1. It currently conveys road and agricultural runoff with the treated effluent from the landfill into Petronila Creek. Petronila Creek flows into Alazan Bay and eventually into Baffin Bay, contributing sediment and nutrient (e.g., total nitrogen and total phosphorus) loads into the Baffin Bay coastal watershed. Reduction of sediment and nutrient levels in the runoff and leachate waters of Petronila Creek would improve the water quality of the watershed. See the proposed Petronila Creek Constructed Wetlands alternative discussion in Section 3.4.1 for background on the historical and current conditions of the area.

Vegetated buffer/filter strips are well-known for effectiveness in removing sediments and pollutants in storm and surface water runoff through trapping, settling, and filtration processes (White and Hanson 2020). The stalks, stems, branches, and foliage of appropriate vegetation provide resistance to flooding; absorbing flow energy rather than deflecting and accentuating, as is the case with hardened structures and straight ditches. Most importantly for coastal watersheds, vegetation provides water quality benefits by filtering soil particulates and nutrients from surface water. The alternative would reduce the amount of sediment and nutrient levels in the water as it drains through the re-engineered flow-way, in addition to creating riparian habitat.

This alternative would include planning, and construction of a meandering flow-way with a vegetated buffer along the ditch. Planning activities would include 1) conducting conceptual planning, preparation of final E&D, permitting, and cost estimates; 2) preparing a long-term site management plan; and 3) conducting landowner and conservation easement holder coordination. Considerations for planning would include site topography, hydrology, soil characteristics, plant selection, and other project-specific and site-specific variables.

One of the Texas TIG agencies would be the Implementing Trustee. The Texas TIG would identify a project partner to provide long-term management and maintenance of the restored ditch.

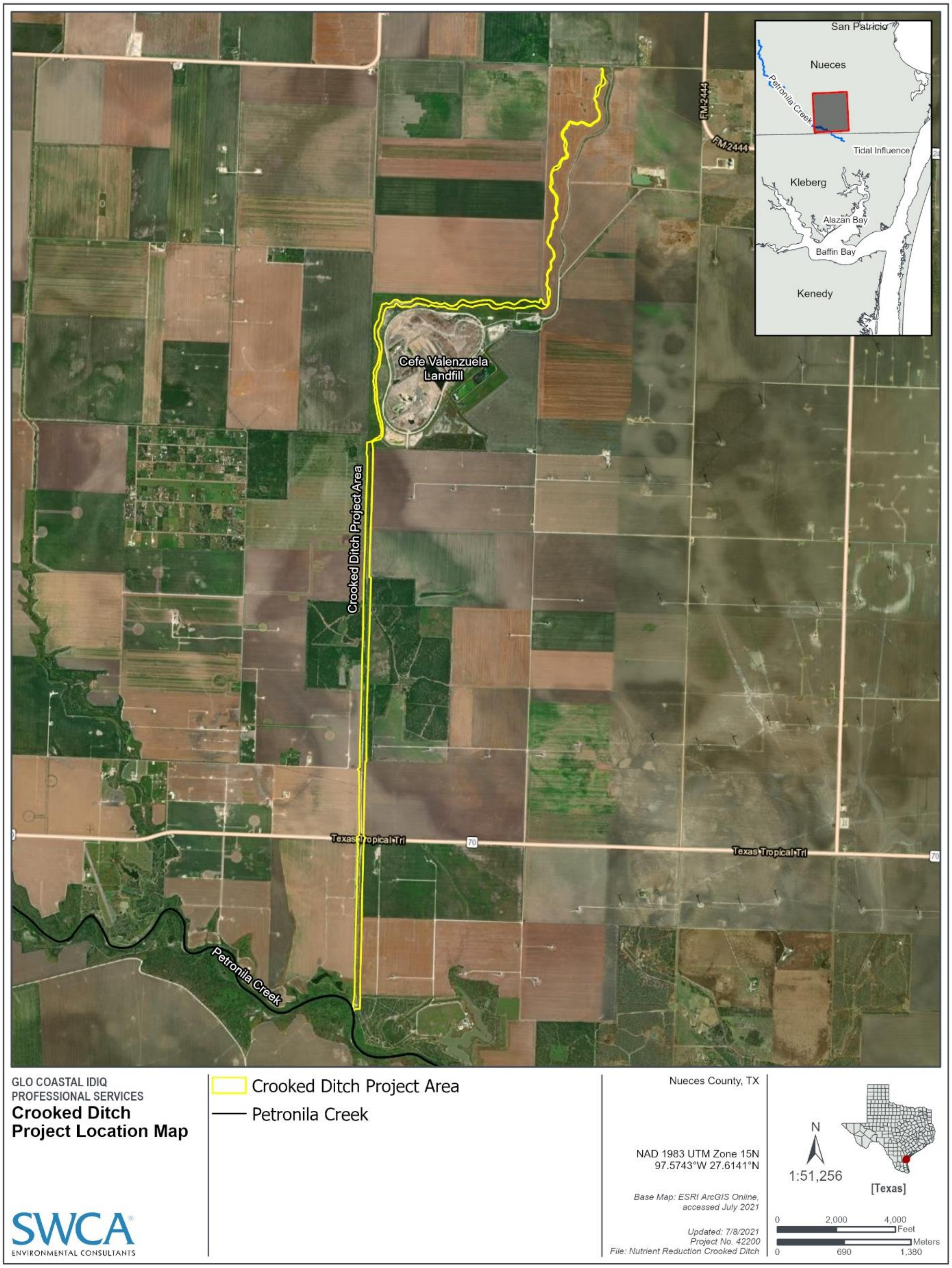

Figure 3-8. Crooked Ditch location map.

3.4.3.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Petronila Creek Crooked Ditch Restoration	**Cost-effectiveness:** The estimated cost of this proposed alternative is $6,500,000 to be funded from Nutrient Reduction restoration type dollars. The total cost is higher than other evaluated nutrient reduction alternatives. Additionally, the alternative's area of impact would be smaller than other evaluated nutrient reduction alternatives (resulting in lower amounts of sediment and nutrient removal), and the alternative would require long-term stewardship. Therefore, nutrient reduction activities would be less cost-effective than other evaluated nutrient reduction alternatives in the RP/EA #2.
	Goals and objectives: The proposed alternative would convert a portion of a channelized ditch back into a meandering flow-way with a vegetated buffer in order to reduce nutrient loadings and is therefore consistent with the Trustee programmatic goal of Restore Water Quality and the Nutrient Reduction restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to the injuries from the oil spill by reducing nitrogen, phosphorus, and sediment pollutant loads to Gulf of Mexico coastal watersheds. The health of the Gulf of Mexico depends upon the health of its estuaries, and the health of those coastal waters is influenced by land use upstream along tributary rivers. This project is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative is technically feasible and uses proven techniques with established methods and documented results. Vegetated buffer/ filter strips are well-known for their effectiveness in removing sediments and pollutants in storm and surface water runoff through trapping, settling, and filtration processes. However, long-term success of the alternative would require extended site stewardship to ensure ecosystem benefits for the life of the alternative, once implemented. Current ownership of each site, potential for long-term landowner cooperation, and maintenance requirements of the ditch are unknown. These uncertainties make likelihood of success low.
	Prevents future injury and avoids collateral injury: Construction of the meandering flow-way with a vegetated buffer could result in a temporary impact to habitat from ground-disturbing activities and noise. The proposed alternative would avoid and minimize collateral injury through implementation of BMPs described in the Final PDARP/PEIS (DWH Trustees 2016a). Further, the implementation of the alternative would ultimately contribute to healthier and more resilient downstream coastal ecosystems that were injured by the DWH oil spill.
	Benefits multiple resources: The alternative could benefit multiple resources due to future reductions in nutrient losses from the landscape and the resulting reductions in nutrient loads to streams and downstream receiving waters; this would provide benefits to recreational users as well as varied coastal and marine resources. The alternative would also provide riparian habitat, which would help to conserve marine, coastal, and estuarine resources along the Texas Gulf Coast.
	Public health and safety: The alternative, if implemented, would result in beneficial impacts to water quality in the watershed, which reduces risks to public health and safety. In addition, appropriate safety and public health measures would be incorporated during planning and implementation.
	Summary: Based on the OPA analysis, this alternative was not identified as a preferred alternative at this time in this document. Although the alternative meets Trustees goals and objectives and would benefit multiple resources, uncertainties regarding long-term site stewardship and maintenance would reduce the likelihood of success. Additionally, the cost-effectiveness of the alternative is reduced compared to other evaluated nutrient reduction alternatives in the RP/EA #2. This project is not a preferred alternative at this time as compared to other alternatives considered in this restoration type in this document.

3.5 OPA NRDA Evaluation of Oyster Alternatives

3.5.1 Landscape Scale Oyster Restoration in Galveston Bay

3.5.1.1 PROJECT DESCRIPTION

The Landscape Scale Oyster Restoration alternative is located in the Galveston Bay system, Texas, (Figure 3-9). This alternative proposes to restore approximately 50 acres of degraded subtidal and intertidal oyster reefs across the Galveston Bay system. The alternative would involve construction of a network of intertidal and subtidal reef complexes focusing on Trinity Bay and Upper-Galveston Bay. Focusing restoration efforts in the Galveston Bay system would provide increased benefits due to the multiple restoration efforts cumulatively adding to the resilience of the Galveston Bay oyster meta-population. The estimated total cost of this proposed alternative is $9.5 million.

This proposed alternative would include 1) site assessment, E&D and permitting; 2) construction; and 3) monitoring. In the event that construction activities would occur adjacent to bird nesting locations, construction activities would be scheduled to avoid bird nesting season. TPWD would be the Implementing Trustee.

The network of reef complexes would include subtidal, high vertical relief reefs and lower-elevation reefs in both intertidal and subtidal zones. Reef geometries may include mounds, ridges and flat layers depending on the site conditions as determined during the site selection process. High vertical relief reefs would serve as sanctuary reefs for oyster recruitment and broodstock sources. Lower-elevation reefs in intertidal areas would also serve as sanctuaries if located in areas where harvest is restricted or prohibited (31 Texas Administrative Code Section 58.21). The low-elevation reefs in the subtidal area would be designed to increase substrate availability while supporting sustainable oyster harvests outside of the project area. These reefs would be positioned so that the predominant currents would transport larvae among reef complexes. This network approach allows for increased oyster population sustainability and oyster habitat resiliency while maximizing the benefits to oyster fisheries through larval supply and transport.

The specific sites for oyster reef restoration would be determined as part of the site-suitability analysis. Site selection would be based on several biotic and abiotic factors. Models of hydrodynamics and water quality conditions including the Galveston Bay TxBLEND (Guthrie et al. 2014) and the Oyster Habitat Restoration Suitability Tool (Beseres-Pollack et al. 2012) would be used to determine the suitability of water conditions at each potential oyster reef restoration site. The TPWD's site degradation index, which uses information on oyster populations and live oyster abundance on each reef, would be used to prioritize oyster reef restoration based on their level of degradation and therefore, need for restoration.

The number and dimensions of the reef structures have not yet been determined but would be dependent on the selected sites' geophysical characteristics and hydrological characteristics. The sanctuary oyster reef would be constructed with cultch material that is larger than 4-inch median-sized cultch if restoration is occurring in harvestable waters. If restoration occurs in protected waters (e.g., prohibited and restricted areas, areas within 300 feet from the shoreline), then smaller cultch size may be used. Cultch would be clean and free of hazardous materials, and could be river rock, limestone, shell, clean crushed concrete, or any other material approved by TPWD. Reef structures would be built so that they are perpendicular to the dominant current direction to facilitate larval supply and transport within the network of reef complexes. Any sanctuary reefs would be located in areas so degraded that they would not be expected to ever recover naturally and thus are not being taken out of production from the industry.

The oyster reef complexes would rely on natural recruitment and would not be seeded. If the proposed alternative is ultimately selected for implementation, the Texas TIG could consider seeding options as corrective action or adaptive management if natural recruitment does not meet success criteria during monitoring. Alternative seeding options include shell recycling programs or purchasing seed. If seeding were to occur, all required Introduction Permits would be obtained and seed source would conform to TPWD's biosecurity protocols for oyster genetics and diseases.

Construction activities would include transporting the cultch material via barges to the site locations. Mounds of cultch material would then be placed on the selected locations using an excavator from a deck barge. Construction is not anticipated to involve dredging activities for site access. Following placement, any debris placed beyond the boundary of the reef would be removed by hand or excavator, as required by applicable permits or leases. Construction activities would be confined to daylight hours. The U.S.

Coast Guard (USCG) would be consulted to determine requirements of signage and navigational aids and all actions would be in compliance with a required U.S. Army Corps of Engineers (USACE) permit.

This alternative may use community-based approaches for construction of the intertidal oyster reef complexes as a potential cost-saving measure. This approach may include recycled shell bagging and placement events with Galveston Bay Foundation as a partner. This approach would be implemented upon completion of the site selection and permitting process. Community-based approaches would only be used if these approaches do not increase costs. Resiliency, sea level rise, and other environmental factors would be considered during the engineering and design portion of the project. The Texas TIG anticipates that the alternative would be designed for a 20- to 25-year life span.

The MAM plan for this proposed alternative is in Appendix A.

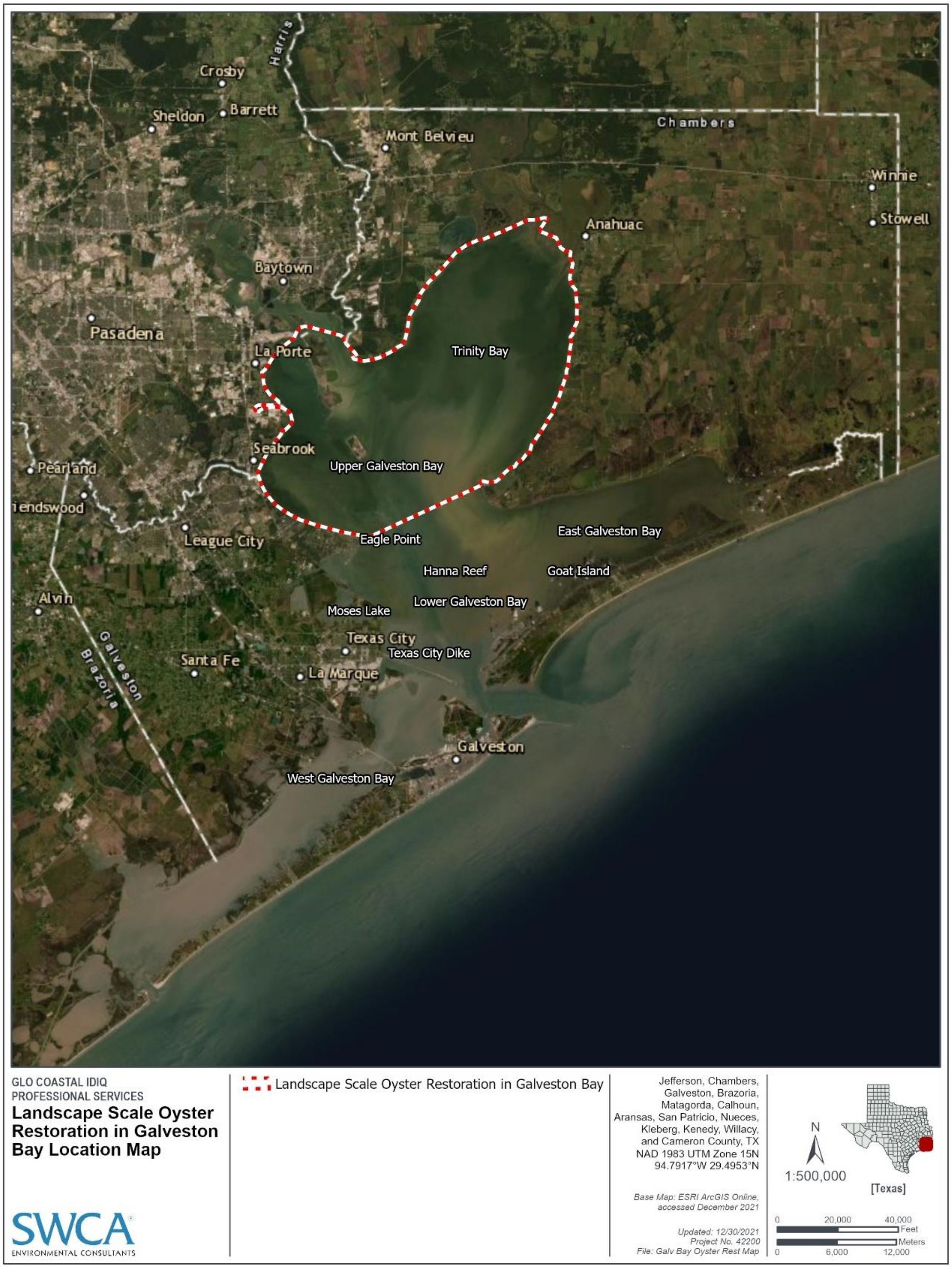

Figure 3-9. Landscape Scale Oyster Restoration in Galveston Bay location map.

3.5.1.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Landscape Scale Oyster Restoration in Galveston Bay	**Cost-effectiveness:** The estimated cost of this proposed alternative is $9,500,000 to be funded from Oyster restoration type dollars. This cost is deemed reasonable because the cost per acre is comparable to the average unit cost for recent oyster restoration projects by TPWD and across the northern Gulf of Mexico, as described in the *RW RP/EA #1* (RW TIG 2021). This alternative is also cost effective because it leverages other oyster restoration work in the Upper Galveston and Trinity Bays.
	Goals and objectives: The proposed alternative would restore approximately 50 acres of degraded subtidal and intertidal oyster reefs, which is consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resource and the Oyster restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to injuries to oysters caused by the spill and is consistent with the restoration approach to restore oyster reef habitats in the Final PDARP/PEIS (DWH Trustees 2016a) and the DWH Oil Spill Natural Resources Damage Assessment: Strategic Framework for Oyster Restoration Activities (DWH Trustees 2017a). Construction of oyster reefs would restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs. This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative would be implemented using methods that are well-established and have been proven to be successful. The proposed oyster reef construction methods have been proven as effective in recruiting and developing broodstock. The Texas TIG has implemented other projects of similar nature and scope successfully, including the Keller Bay Oyster Reef Restoration project and the Restoration of Buried Oyster Reefs in Galveston Bay project, and has participated in the planning, design, and oversight of these oyster restoration projects. Therefore, the alternative would have a high likelihood of being successful.
	Prevents future injury and avoids collateral injury: Aside from the potential for minor disturbances during construction, the proposed alternative is not expected to cause substantive collateral injury to natural resources. The proposed alternative would avoid and minimize collateral injury to the aquatic habitat and species that may either use the area or constructed oyster reef complexes through implementation of BMPs described in the Final PDARP/PEIS (DWH Trustees 2016a). Although the creation of oyster reefs would result in the burial of habitat beneath the newly created reefs, the footprint of habitat loss would be relatively small, and the injuries incurred are expected to be more than offset by the oyster habitat being created. Additionally, the materials used to construct the oyster reef complexes would be clean and free of hazardous materials. Creation of new reefs would also increase the resilience of oysters to potential sources of future injury.
	Benefits multiple resources: The construction of oyster reef complexes would benefit multiple resources. The Galveston Bay oyster population would benefit from the production of spawning stocks and larval recruitment areas. These oyster reef complexes would also provide ecosystem services such as habitat for other aquatic species and water quality enhancement. The oyster reef complexes would also benefit recreation fishing and commercial oyster fishery activities once construction is complete. Additionally, this alternative would contribute to ecosystem scale benefits in Galveston Bay when viewed together with the GEBF-funded Galveston Bay Sustainable Oyster Reef Restoration project (NFWF 2021) and the RW TIG's East Galveston Bay Oyster Restoration project; Portal ID # 172; https://www.gulfspillrestoration.noaa.gov/project?id=172 (RW TIG 2021).
	Public health and safety: The proposed alternative would minimize adverse effects to public health and safety during development via precautions and provisions such as temporary restriction or limits to recreational activities near the sites during construction, and/or implementation of U.S. Coast Guard requirements, such as notices to mariners, temporary lights on equipment and material barges, and standard safety practices. Additionally, the materials used to construct the oyster reef complexes would be clean and free of hazardous materials. The proposed alternative would benefit public health and safety by providing shoreline protection and abatement of storm surges to the surrounding area. New reefs would be added to navigation charts to avoid possible navigation impacts.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets Trustees goals and objectives; provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated. The Texas TIG determined that focusing restoration efforts in Galveston Bay would provide increased benefits due to the multiple restoration efforts cumulatively adding to the resilience of the Galveston Bay oyster meta-population.

3.5.2 St. Charles Bay Oyster Reef Restoration

3.5.2.1 PROJECT DESCRIPTION

The St. Charles Bay Oyster Reef Restoration alternative is located in St. Charles Bay within the Mission-Aransas National Estuarine Research Reserve and adjacent to Goose Island State Park in Aransas County, Texas (Figure 3-10). This alternative proposes to restore approximately 30 acres of intertidal and subtidal oyster reef habitat, expanding an area of oyster reef that was successfully restored between 2017 and 2021. The estimated total cost of this proposed alternative is $2.5 million.

The alternative would restore oyster abundance and spawning stocks, support resiliency and diversity of oyster populations, and create a structurally complex habitat for use by fish and other estuarine organisms in St. Charles Bay. Previous mapping efforts indicate that the areas proposed for oyster reef restoration contain habitat parameters that could support viable and self-sustaining oyster populations. These areas are closed to commercial and recreational oyster harvest and have been identified as a target for restoring oyster populations, supporting recreational fishing, and protecting an eroding shoreline.

This alternative would include 1) E&D and permitting; 2) construction; and 3) monitoring. The TPWD would be the Implementing Trustee.

The subtidal reef complex would be constructed using shallow-draft barges using a dragline to place substrates as a series of rectangular-trapezoidal reef mounds oriented parallel to the shoreline. This layout would provide additional benefits of wave buffering and shoreline protection. Shallow water barges would be used to stage materials and place rectangular-trapezoidal mounds in the intertidal zone (< 0.5 m water depth) to support the high productivity of intertidal fauna. The number and dimensions of the subtidal and intertidal reef mounds have not yet been determined but would be dependent on the selected sites' geophysical characteristics and hydrological characteristics. Construction is not anticipated to involve dredging activities for site access. The materials to construct both the subtidal and intertidal oyster reef complexes would consist of similar types of TPWD-approved cultch material as described above in Section 3.5.1. The oyster reef complexes would rely on natural recruitment and would not be seeded. If there is a need for corrective actions, the Texas TIG could consider seeding options similar to what was described, above, for the other oyster alternative. The restored reef would be designed to maximize available resources and create a structurally complex habitat for use by fish and other estuarine organisms.

After the reef mounds are constructed, community-based restoration events would be conducted to provide hands-on opportunities for volunteers to restore coastal habitats and promote shared natural resource stewardship. The community may be involved through oyster gardening activities, such as growing oysters in mesh bags filled with shells and hung from piers. The USCG would be consulted to determine requirements of signage and navigational aids as described in Section 3.5.1 and in compliance with a USACE Nationwide Permit 27 that would be secured prior to construction. Resiliency, sea level rise, and other environmental factors would be considered during E&D. The Texas TIG anticipates that the alternative would be designed for a 20- to 25-year life span.

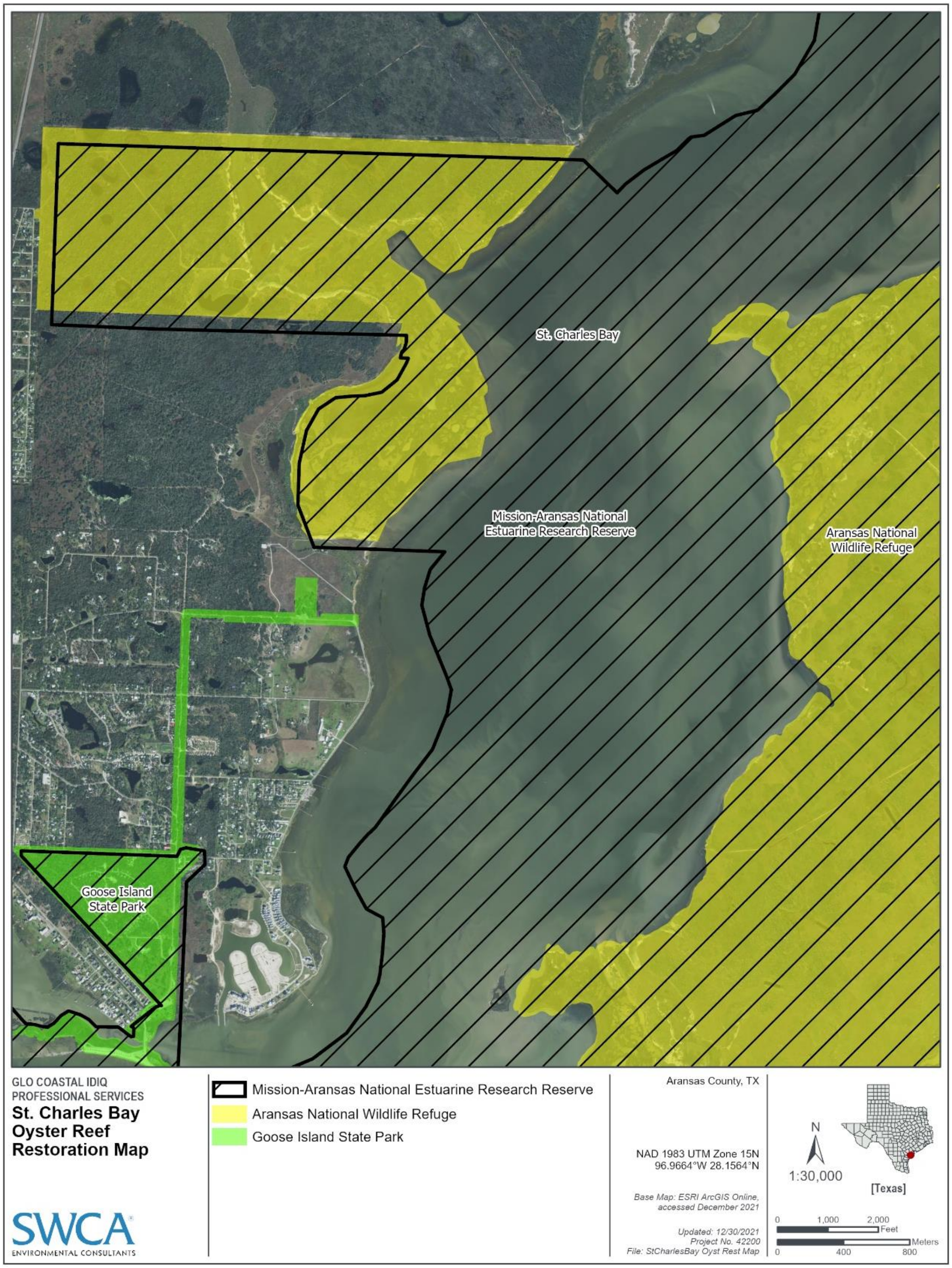

Figure 3-10. St. Charles Bay Oyster Reef Restoration location map.

3.5.2.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
St. Charles Bay Oyster Reef Restoration	**Cost-effectiveness:** The estimated cost of this proposed project is $2,500,000 to be funded from Oyster restoration type dollars. The cost is deemed reasonable because the cost per acre is lower than the average unit cost for recent oyster restoration projects across the northern Gulf of Mexico, as described in the *RW RP/EA #1* (RW TIG 2021).
	Goals and objectives: The proposed alternative would restore the oyster reef populations of St. Charles Bay through construction of subtidal and intertidal reef complexes and is, therefore, consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resource and the Oyster restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to injuries to oysters and is consistent with the restoration approach to restore oyster reef habitats in the Final PDARP/PEIS (DWH Trustees 2016a) and the DWH Oil Spill Natural Resources Damage Assessment: Strategic Framework for Oyster Restoration Activities (DWH Trustees 2017a). Construction of oyster reefs would restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs. This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative would implement well-established construction methods that have been proven successful. The Texas TIG has successfully implemented other projects of a similar nature and scope, and has participated in the planning, design, and oversight of several other similar oyster restoration projects. The proposed alternative includes a siting process to construct the complex in an area that would allow for successful construction, colonization, and establishment of the oyster reef complexes. Therefore, the alternative would have a high likelihood of being successful.
	Prevents future injury and avoid collateral injury: Aside from the potential for minor disturbances during construction, the proposed alternative is not expected to cause substantive collateral injury to natural resources. The proposed alternative would avoid and minimize collateral injury to the aquatic habitat and species that may either use the area of constructed oyster reef complexes through implementation of BMPs described in the Final PDARP/PEIS (DWH Trustees 2016a). Additionally, the materials used to construct the oyster reef complexes would be clean and free of hazardous materials.
	Benefits multiple resources: The construction of oyster reef complexes would benefit multiple resources. The Charles Bay oyster population would benefit from the production of spawning stocks and larval recruitment areas. These oyster reef complexes would also provide ecosystem services including as habitat for other aquatic species and water quality enhancement. The oyster reef complexes would also benefit recreation fishing and commercial oyster fishery activities once construction is complete.
	Public health and safety: The proposed alternative would minimize adverse effects to public health and safety during development via precautions and provisions such as temporary restriction or limits to recreational activities near the site during construction, and/or implementation of U.S. Coast Guard requirements, such as notices to mariners, temporary lights on equipment and material barges, and standard safety practices. Additionally, the materials used to construct the oyster reef complexes would be clean and free of hazardous materials. The proposed alternative would benefit public health and safety by providing shoreline protection and abatement of storm surges to the surrounding area.
	Summary: Based on the OPA analysis, this alternative was not identified as a preferred alternative at this time in the RP/EA #2. Although the alternative is reasonable in cost, meets Trustees goals and objectives, and benefits multiple resources, the Texas TIG determined that focusing restoration efforts in Galveston Bay would provide increased benefits due to the multiple restoration efforts cumulatively adding to the resilience of the Galveston Bay oyster meta-population. This project is not a preferred alternative at this time as compared to the other alternative considered in this restoration type in this document.

3.6 OPA NRDA Evaluation of Sea Turtle Alternatives

3.6.1 Upper Texas Coast Sea Turtle Rehabilitation Facility

3.6.1.1 PROJECT DESCRIPTION

The Upper Texas Coast Sea Turtle Rehabilitation Facility would be located on Pelican Island in the City of Galveston, Galveston County, Texas, on the Texas A&M University at Galveston (TAMUG) campus, west of Seawolf Parkway (Figure 3-11). This alternative would involve the construction of a new sea turtle rehabilitation facility and parking lot on a previously disturbed area of land that was used as a dredge placement facility located directly northwest of the TAMUG Campus Wetland Center. A total of $2,500,000 in funding would be provided under this proposed alternative; remaining funding for the total estimated project cost of $10,500,000 would come from previous financial commitments from RW RP/EA #1 (RW TIG 2021), and other funding sources. If selected by the Texas TIG in the Final RP/EA #2, this alternative would only be implemented if sufficient funding through other sources is allocated so that the entire facility is constructed.

The Sea Turtle Stranding and Salvage Network (STSSN) is a network of federal, state, and private partners that was established in 1980 to document strandings of sea turtles along the coastal areas from Maine to Texas and in portions of the U.S. Caribbean. The program informs "causes of morbidity and mortality in sea turtles by responding to and documenting sea turtles, found either dead or alive (but compromised), in a manner sufficient to inform conservation management and recovery" (NOAA 2021a). The proposed facility would replace lost rehabilitation capacity and address a network gap resulting from the impending closure of an existing rehabilitation facility. Without this facility, the STSSN lacks rehabilitation capacity on the upper Texas coast, and stranded sea turtles would need to undergo 3.5 to 5.5 hours of travel (depending on location) to reach the nearest rehabilitation facility. Thus, this proposed new facility would address this network gap and expand regional coverage on the upper Texas coast by providing quicker response and rehabilitation time for stranded sea turtles, which may in turn increase the number of sea turtles successfully rehabilitated and released back to the wild.

This alternative would include 1) E&D, 2) construction, 3) provision of equipment and supplies, and 4) monitoring. TGLO would be the Implementing Trustee. The Implementing Trustee would coordinate the project with TAMUG, the Texas STSSN Coordinator, the Texas TIG, and the RW TIG, which is also providing funding through RW TIG RP/EA #1, (RW TIG 2021).

Following the initial planning, which consists of securing project funding and E&D, construction activities would include clearing and grading an upland area located within the existing dredge placement area and construction of the facility, parking area, and driveways (i.e., the construction footprint). Areas outside the immediate construction footprint could be used to stage equipment and materials (e.g., fill); however, this would be temporary and limited in extent. The addition of impervious surfaces within the construction footprint would result in the permanent modification of approximately two acres of the site, although pervious materials could also be incorporated if feasible. Access to the facility would be provided by existing access roads; no additional access roads would be constructed as part of this alternative. Any areas disturbed by construction activities that are not within the construction footprint would be revegetated with native species following construction. A stormwater pollution prevention plan (SWPPP) would be prepared according to TCEQ standards. As part of this alternative, funding would also be used to purchase 1) life support systems for two hospital wards and 2) supplies and equipment for sea turtle holding areas at the facility. Details regarding facility equipment are provided as part of the RW RP/EA #1 (RW TIG 2021).

The MAM plan for this proposed alternative is in Appendix A.

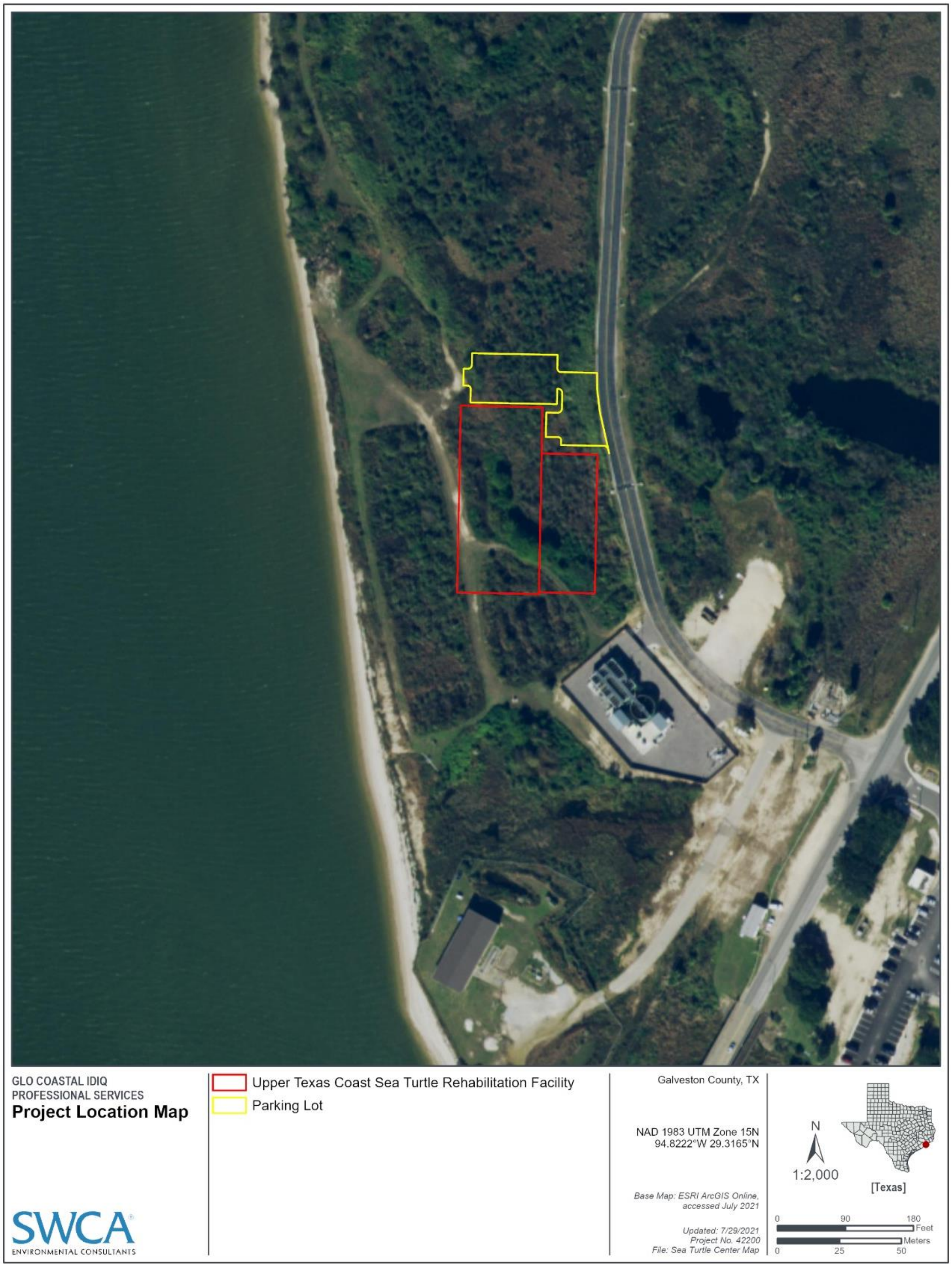

Figure 3-11. Upper Texas Coast Sea Turtle Rehabilitation Facility location map.

3.6.1.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Upper Texas Coast Sea Turtle Rehabilitation Facility	**Cost-effectiveness:** The estimated cost of this proposed alternative is $2,500,000 to be funded from Sea Turtle restoration type dollars. This amount, combined with additional funding from RW RP/EA #1 and other secured sources, would be used to fund the total estimated cost of $10,500,000. This alternative is cost effective because it leverages other sources of funds and would only be implemented if sufficient funding is allocated to construct the entire facility. The RP/EA #2 also incorporates by reference findings made in the RW RP/EA #1 (RW TIG 2021), which determined that the proposed costs are reasonable and appropriate, based on similar past projects (such as Florida's marine mammal pathobiology facility) and expert knowledge.
	Goals and objectives: The proposed alternative would provide funding to support construction of a new sea turtle rehabilitation facility, which is consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resources and the Sea Turtle restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a) and the DWH Oil Spill Natural Resource Damage Assessment: Strategic Framework for Sea Turtle Restoration Activities (DWH Trustees 2017b). The proposed alternative has a clear nexus to injuries to sea turtles and is consistent with the Final PDARP/PEIS restoration approach to increase sea turtle survival through enhanced mortality investigation and early detection of and response to anthropogenic threats and emergency events by enhancing rehabilitation capabilities where necessary as described in the above framework (DWH Trustees 2017b). The alternative would address primary threats to all life stages (hatchling, juvenile, and adult) and species of sea turtles and support existing conservation efforts by ensuring consistency with sea turtle recovery plans and recovery goals. Without replacing this lost rehabilitation capacity on the upper Texas coast, sea turtles would need to travel hundreds of miles to existing facilities, which could cause additional stress and delay necessary care. This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative is technically feasible and uses proven techniques with established methods and documented results. Construction of the facility would be contracted out to a partner organization. The Texas TIG and RW TIG would oversee the construction activities to ensure success of the facility construction. This alternative would help support the STSSN, a well-established, effective sea turtle stranding network that has historically operated across the region with the continued cooperation of federal, state, and non-government organization partners. The established network and partnership are evidence that this alternative is likely to succeed. The STSSN has demonstrated the ability to successfully respond to stranding events and rehabilitate sea turtles; this alternative would improve its ability to accomplish these actions. Further, partial funding for implementation of the Sea Turtle Rehabilitation Facility alternative has already been selected in the RW RP/EA #1 (RW TIG 2021), which increases likelihood of project success.
	Prevents future injury and avoids collateral injury: Aside from the potential for minor disturbances during construction, the proposed alternative is not expected to cause collateral injury to natural resources. Building the proposed rehabilitation facility would result in a minor loss of coastal habitat, as well as associated noise and human activity, but most impacts would be temporary. Long-term losses would be limited to the 2-acre facility footprint. The facility would be designed to avoid and minimize collateral injury to the extent practicable, and construction would be conducted in accordance with applicable and relevant permits. Sea turtle rescues and rehabilitation would be conducted under long-term existing programs with established regulatory requirements and permits that would prevent collateral injury to handled and rehabilitated animals. Purchase of rehabilitation equipment would not impact natural resources.
	Benefits multiple resources: The proposed alternative would benefit multiple species of sea turtles that require rehabilitation.
	Public health and safety: The proposed alternative would minimize adverse effects to public health and safety during construction and implementation via compliance with all relevant safety practices and regulations, such as the SWPPP. No hazardous materials would be generated as a result of this alternative.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets Trustees goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.6.2 Lancha Sea Turtle Mitigation Plan

3.6.2.1 PROJECT DESCRIPTION

The Lancha Sea Turtle Mitigation Plan alternative would be conducted in state and federal waters on the southern Texas coast, primarily from Corpus Christi, Texas to the U.S.-Mexico border. This alternative would result in the 1) purchase of long-range vessel(s) and2) enhanced enforcement and/or patrol efforts to apprehend illegal vessels (primarily illegal vessels from Mexico known as lanchas) and remove illegal fishing gear from the water (e.g., gill nets and longline gear). In addition, the alternative may result in the procurement of dock space for vessel(s) used for this project and the installation of a floating dock for those vessel(s). A total of $2,200,000 in funding would be provided under this proposed alternative; remaining funding for the total estimated project cost of $8,400,000 would come from other sources. If selected by the Texas TIG in the Final RP/EA #2, this alternative would only be implemented if funding through other sources is allocated so that there would be dedicated vessel(s) and funds for a minimum of five years of patrols.

Bottom longline fishery operated by illegal fishers from Mexico is depicted typically with the terminal end of the fishing gear consisting of monofilament, connected to a short wire leader, then connected to a circle hook (Figure 3-12; Stacy et al. 2018).

Figure 3-12. Comparison of gear recovered from stranded sea turtles (taken from Stacy et al. 2018).

The lancha fleet uses illegal longline gear and gill nets to target red snapper and sharks, incidentally catching and killing sea turtles. This illegal gear is most frequently set 15 to 30 miles offshore, encompassing an approximately 3,000-square-mile offshore area from Corpus Christi in the north to the U.S.-Mexico international maritime boundary in the south (Figure 3-13). This alternative would purchase vessel(s) capable of extended trips. Following purchase of the vessel(s), TPWD law enforcement would patrol these waters and apprehend lancha vessels that are illegally fishing. Patrols would likely traverse the lower Gulf of Mexico two times each month. In the event remote sensing equipment is made accessible, TPWD could perform patrols with fewer personnel and vessels. However, all targeted patrols would be performed at times most likely to deter illegal fishing activity.

Illegal fishing vessels, practices and gear contribute to injury or death of sea turtles by entanglement in debris created by illegal fishing and the capture of sea turtles in fishing nets. This project would enhance the ability of enforcement personnel to identify and prevent illegal activities that cause injury and mortality to sea turtles in U.S. waters. It is expected that this alternative would prevent some vessels from breaking the law and deter future illegal fishing operations, thus reducing sea turtle injuries and mortalities. TPWD would be the Implementing Trustee.

Implementation of these activities may result in releasing illegally captured live marine resources, documenting the type and number of dead marine resources, and transporting carcasses for necropsy or disposal. The Texas TIG anticipates that all dead sea turtles would be transferred to the STSSN for necropsy, live injured sea turtles would be transferred to the STSSN for evaluation and rehabilitation, and live uninjured sea turtles would be documented and released on-site, if safe to do so. Stranding reports would be completed for sea turtles that are encountered during patrols, which could help inform future restoration needs.

The MAM plan for this proposed alternative is in Appendix A.

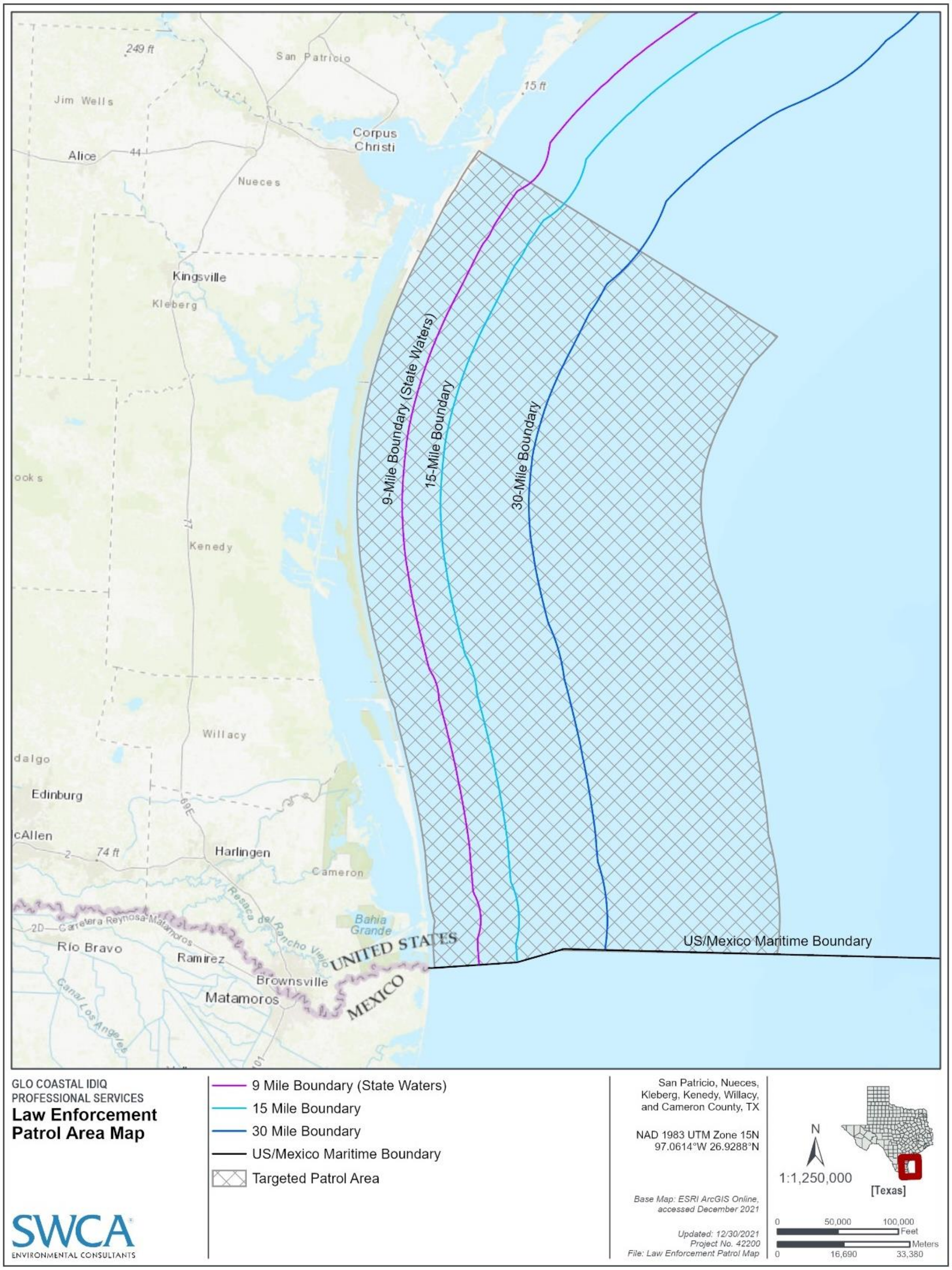

Figure 3-13. Anticipated Project Patrol area map.

3.6.2.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Lancha Sea Turtle Mitigation Plan	**Cost-effectiveness:** The estimated cost of this proposed alternative is $2,200,000 to be funded from Sea Turtle restoration type dollars. This amount, combined with additional funding from other sources, would be used to fund the total estimated project cost of $8,400,000. The estimated budget for this alternative were developed based upon the anticipated costs of a vessel(s) that would be appropriate to conduct the work and similar activities (e.g., cost of other law enforcement activities) that have been conducted in the past. Additionally, data collected as part of patrols would help inform future enforcement efforts, which could result in greater cost efficiencies over time. The Texas TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate. This alternative is also cost effective because it leverages other sources of funds and would only be implemented if sufficient funding is allocated so that there is a dedicated boat and funds for a minimum of five years of patrols.
	Goals and objectives: The proposed alternative would contribute funding for the purchase of a long-range boat vessel(s) and conducting enhanced enforcement effort and/or patrols primarily in offshore waters near the southern Texas coast. This proposed alternative is consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resources and the Sea Turtle restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a) and the DWH Strategic Framework for Sea Turtle Restoration Activities (DWH Trustees 2017b). The proposed alternative has a clear nexus to injuries to sea turtles and is consistent with the Final PDARP/PEIS restoration approach to reduce sea turtle bycatch in commercial fisheries through enhanced state enforcement efforts (e.g., additional personnel, equipment, and vessels) as described in the above framework (DWH Trustees 2017b). This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: Illegal fishing in Texas waters is a known threat to sea turtles and law enforcement efforts have been used in the past to find lanchas fishing in U.S. waters and to remove illegal gear that is harming sea turtles. Therefore, the Texas TIG believes that enhanced enforcement and/or patrols would have a high likelihood of success. Data produced by these efforts would be used to inform the need, location, and frequency of future enforcement efforts. In addition to the vessel(s), the project funding would ensure five years of patrols.
	Prevents future injury and avoids collateral injury: The proposed alternative could result in minor impacts to natural resources associated with installation of the dock. Other activities would not result in collateral injuries to natural resources. Purchase of vessel(s) and extended patrols would not result in new potential resource impacts. Further, both targeted and non-targeted species would likely benefit from reductions in illegal fishing operations.
	Benefits multiple resources: The proposed alternative would benefit multiple species of sea turtles that could be harmed by Illegal fishing gear, including Kemp's ridley, loggerhead, and green sea turtles. This alternative would also benefit multiple aquatic species including those targeted by illegal fishers (i.e., red snapper and sharks) and those incidentally caught (e.g., dolphins).
	Public health and safety: The Texas TIG does not anticipate negative impacts to public health and safety as a result of this alternative. TPWD would comply with all relevant safety measures, practices, and regulations during implementation to maintain a safe, protective environment for those involved with the alternative.
	Summary: Based on the OPA analyses, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets Trustees goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.6.3 Kemp's Ridley Sea Turtle Nest Protection

3.6.3.1 PROJECT DESCRIPTION

The Kemp's Ridley Sea Turtle Nest Protection alternative is located along the Texas Gulf Coast in Jefferson, Chambers, Galveston, Brazoria, Matagorda, Calhoun, Aransas, Nueces, Kleberg, Kenedy, Willacy, and Cameron Counties. This effort would be separated into five nest protection areas: 1) upper Texas coast; 2) mid Texas coast; 3) San Jose and Mustang Islands; 4) North Padre Island; and 5) South Padre Island (Figure 3-14). This alternative proposes to continue nest detection and protection activities along the Texas Gulf Coast, as well as implementing adult sea turtle satellite tracking activities. The estimated total cost of this proposed alternative is $2,200,000.

Approximately 95% of Kemp's ridley sea turtles (*Lepidochelys kempii*), an endangered species, nest on beaches in Tamaulipas, Mexico (NOAA 2021b). For over 40 years, a multiagency binational effort has worked toward establishing a secondary nesting colony at Padre Island National Seashore (PAIS) as a safeguard against species extinction should a catastrophic event occur in Mexico. Comprehensive beach patrols along the Texas Gulf Coast began in 1998 in order to "locate, document, and protect nesting Kemp's ridley sea turtles and their nests" (NPS 2020). Of the Kemp's ridley nests in the United States, the majority are found in south Texas (Mustang Island and south), with approximately 52% of U.S. Kemp's ridley's nests found at PAIS (NPS 2020). The continued implementation of beach patrols and adult sea turtle tracking along the Texas Gulf Coast would enhance nest success, increase hatchling productivity, and increase survival of Kemp's ridley sea turtles, as well as identify habitat use, rate of survival, and factors that lead to adult sea turtle mortality through the satellite tracking activity. It is expected that this alternative could protect approximately 200 to 500 Kemp's ridley nests per year, with a release of approximately 20,000 to 50,000 live hatchlings into the Gulf of Mexico along the Texas coast per year. Additionally, this alternative would contribute to the only continuous data set of information collected from adult sea turtle satellite tracking for the Kemp's ridley sea turtle.

This alternative would include: 1) implementation, and 2) monitoring. The DOI would be the Implementing Trustee, and would work with partners anticipated to include PAIS, TAMUG, Amos Rehabilitation Keep, and Sea Turtle, Inc.

From January to March each year, activities would include staff and volunteer onboarding and training, acquisition of needed equipment (e.g., utility task vehicles [UTVs] and fuel, safety equipment and supplies, nest and turtle marking and handling supplies, and education and outreach materials), equipment maintenance, and fulfilling permitting requirements. From April to July, activities would include beach patrols, public education and outreach, nest protection through use of intervention techniques (i.e., relocation), nest incubation in an off-site facility or in beach-side nest corrals, hatchling release, and tagging adult nesting sea turtles with satellite trackers. From August through October, activities would include hatchling release, end-of-season equipment maintenance, data entry, report writing, and annual report preparation.

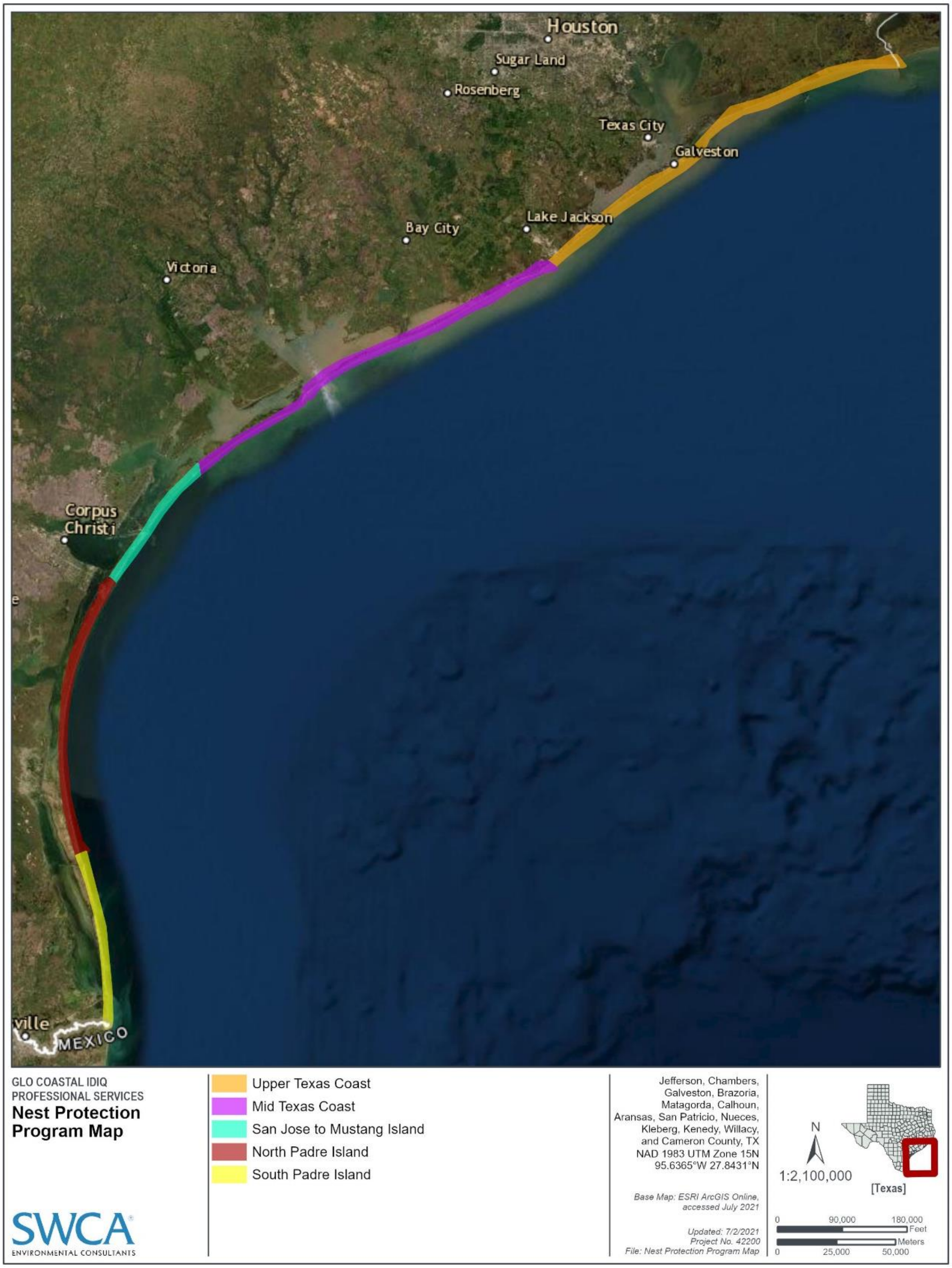

Figure 3-14. Nest Protection location map.

3.6.3.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Kemp's Ridley Sea Turtle Nest Protection	**Cost-effectiveness:** The estimated cost of this proposed alternative is $2,200,000 to be funded from Sea Turtle restoration type dollars. These costs are based on estimates from similar past projects and expertise developed by implementing similar sea turtle nest protection projects, such as the RW TIG project "Sea Turtles Alternative 2: Restore and Enhance Sea Turtle Nest Productivity" (Portal ID #171; https://www.gulfspillrestoration.noaa.gov/project?id=171). The Texas TIG has reviewed these costs and found them to be reasonable and appropriate. The proposed alternative would provide cost efficiencies by 1) using existing data from current programs to inform restoration activities, and 2) using volunteers where appropriate to reduce costs of sea turtle restoration efforts.
	Goals and objectives: The alternative would enhance nest success, increase hatchling productivity, and increase survival of Kemp's ridley sea turtles, and identify habitat use, rate of survival, and factors that lead to adult sea turtle mortality through the satellite tracking activity. Therefore, the goal of this proposed alternative is consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resources and the Sea Turtle restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a) and the DWH Oil Spill Natural Resource Damage Assessment: Strategic Framework for Sea Turtle Restoration Activities (DWH Trustees 2017b). The proposed alternative has a nexus to injuries to sea turtles and is consistent with the Final PDARP/PEIS restoration approach to increase successful nesting, successful emergence of hatchlings from the nest, and survival from the nest to the water in accordance with the technique to enhance protection of nests by addressing anthropogenic threats as described in the above framework (DWH Trustees 2017b). However, this alternative focuses on data gathering and monitoring. After evaluation, this project may be applicable as a data gathering and monitoring program to help document general restoration success for sea turtles rather than as a restoration project.
	Likelihood of success: The proposed alternative would have a high likelihood of success because it would use well-established methods to track and support nesting success. The DOI has a history of successfully implementing similar sea turtle protection projects, thereby improving the likelihood that this effort would be successful. In fact, recent research suggests that the protection of nesting females and sea turtle eggs has contributed to increasing trends in some sea turtle populations over time (Mazaris et al. 2017).
	Prevents future injury and avoids collateral injury: Aside from the potential for minor disturbances during implementation, the proposed alternative is not expected to cause collateral injury to natural resources. The main avenue through which injury to natural resources could potentially occur would be through nest protection and tracking activities (e.g., disturbance or relocation of nests). However, such activities have been successfully implemented for decades with little harm to sea turtles. The project would be conducted under existing ESA permits and would adhere to all established research protocols, and best practices for conducting field work on sea turtles and in sea turtle nesting environments to ensure that collateral injury is avoided.
	Multiple resource benefits: The proposed alternative would directly benefit Kemp's ridley sea turtles and may benefit other species of sea turtles (Green's and loggerhead) by increasing data sets for, and understanding of, sea turtle behavior.
	Health and safety: The Texas TIG does not anticipate negative impacts to public health and safety as a result of this alternative because the alternative would comply with all relevant safety measures, practices, and regulations during implementation to maintain a safe, protective environment for those involved with the alternative.
	Summary: Based on the OPA analysis, this alternative was not identified as a preferred alternative at this time in the RP/EA #2. The alternative is reasonable in cost, has a high likelihood of success, and meets Trustees goals and objectives; however, the TX TIG determined that because this project focuses on data gathering and monitoring, it may be more appropriate to consider as a future MAM activity and is not a preferred alternative at this time as compared to other alternatives considered for this restoration type in this RP/EA.

3.7 OPA NRDA Evaluation of Bird Alternatives

3.7.1 Laguna Vista Rookery Island Habitat Protection

3.7.1.1 PROJECT DESCRIPTION

The Laguna Vista Rookery Island Habitat Protection proposed alternative is located in the lower Laguna Madre about three miles north-northwest of the town of Laguna Vista in Cameron County, Texas (Figure 3-15). The alternative would complete engineering and construct approximately 2,250 LF of living shoreline measures to minimize ongoing erosion and restore the shoreline along the perimeter of the 11-acre Spoil Island. This proposed alternative would protect and restore habitat to benefit colonial waterbirds, including brown pelicans (*Pelecanus occidentalis*), terns (*Sternidae*), skimmers (*Rynchops* sp.), and wading birds. The estimated total cost of this alternative is $2,100,000.

The Laguna Vista Island was created from the placement of dredged sediments during the dredging of one or more now-abandoned navigation channels from historical oil and gas industry activities. The island is an active colonial waterbird rookery island, is currently leased by Audubon Texas, and is managed by CBBEP. The northeastern portion of the island is vegetated, and the western portion is predominantly non-vegetated flats. Both areas are used as nesting habitat by birds (AECOM 2020). Wind and wave erosion are threatening the bird habitat on the island. The northern shoreline of the island is subject to erosive wave energy produced when cold fronts produce strong northerly winds. Review of recent aerial imagery indicates that erosive wave action causes the loss of approximately 10 feet of the northern shoreline annually, eroding both vegetated and non-vegetated portions of the island (AECOM 2020). In addition, the nearshore area around the island has experienced degradation of seagrass and oyster habitat from siltation.

This alternative builds upon the Laguna Vista Spoil Island Shoreline Protection Phase I project that was funded by the USFWS and through the State of Texas Coastal Erosion Planning and Response (CEPRA). Funding of that engineering project, which included preliminary engineering, 70% construction design, and submittal of environmental permits, provided an initial and critical step to minimizing ongoing erosion and restoring the Spoil Island shoreline.

This proposed alternative would 1) finalize E&D and obtain relevant permits, 2) construct restoration features, and 3) implement monitoring. Work at this site would take place outside the nesting activity present on the island, typically between February 14 and September 1. The alternative would involve construction of a breakwater to control erosion, regrading and planting the eroded shoreline, elevating portions of the island, and removing derelict pipes located on the island. Construction methods used to accomplish the alternative could include the following:

- Mechanical dredging to create a floatation channel using a barge-mounted excavator. A channel is needed to provide barge access to the site. The channel could be excavated to a width of approximately 50 feet and a depth that provides no more than four feet of water depth. Approximately 1,800 LF of channel would be required and it is estimated that approximately 15,000 cubic yards (CY) of dredged sediment may be generated by this excavation. The channel would begin at the abandoned navigation channel adjacent to the east side of the island and continue to the island site through the open waters. Dredged sediments would be temporarily placed beside the access channel in areas of bare bay bottom. Where seagrasses are present excavated sediments would be placed temporarily on barges. Excavated sediments would be used to enhance the island or returned to the access channel after the access channel is no longer required. Appropriate BMPs, including silt curtains, would be used to minimize turbidity during dredging.

- Placement of suitable dredged material as upland site fill of low-lying, unvegetated areas within approximately 1.5 acres of the Spoil Island's interior (above the mean high water [MHW] elevation). These low-lying areas have experienced an increased frequency of overwash events making them unsuitable for nesting birds. Elevating these low-lying areas would provide additional habitat for nesting birds.
- A riprap breakwater would be placed within shallow open water offshore parallel to the shoreline on portions of the island to provide protection from wave erosion.
- A riprap revetment would be placed along on approximately 550 LF of the southern shoreline.
- Eroded shoreline areas would be regraded to pre-erosion conditions using in situ sediments. Restoration target elevations would be above the MHW elevation. Native vegetation would be planted to stabilize the regraded shoreline. Approximately 250 CY of shoreline sediments would be regraded to an elevation below the MHW.
- Two derelict pipe culverts located along the shoreline in the southwestern portion of the island would be removed. Pipe removal would occur outside the bird nesting season and would be accomplished with a shallow draft barge and excavator.

Resiliency, sea level rise, and other environmental factors would be considered during final engineering and design. The Texas TIG anticipates that the alternative would be designed for a 20- to 25-year life span. The TGLO and DOI would be the Implementing Trustees, and would work with partners including Texas Audubon, USFWS, and the CBBEP. Texas Audubon, as the USACE permit applicant and state-owned land lease holder, would provide for the long-term management of the restored island and breakwater.

The MAM plan for this proposed alternative is in Appendix A.

Figure 3-15. Laguna Vista Rookery Island Habitat Protection anticipated construction design and location map.

3.7.1.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Laguna Vista Rookery Island Habitat Protection	**Cost-effectiveness:** The estimated cost of this proposed alternative is $2,100,000 to be funded from Bird restoration type dollars. The cost for the proposed alternative is based on similar projects, including those in Florida and Louisiana, such as the Gomez Key Oyster Reef Expansion and Breakwaters for American Oystercatchers (Portal ID #275; https://www.gulfspillrestoration.noaa.gov/project?id=275) and Isle au Pitre Restoration (Portal ID # 264; https://www.gulfspillrestoration.noaa.gov/project?id=264). The proposed alternative would provide cost efficiencies by leveraging existing data and partial design from a prior, approved project. Therefore, the Texas TIG deemed the cost reasonable and appropriate.
	Goals and objectives: The proposed alternative would protect an existing 11-acre rookery island and restore the perimeter and up to 1.5 acres of the island's interior that would enhance and restore nesting and foraging habitat needed by bird species injured in the oil spill, as well as provide hard substrate habitat for invertebrates (mussels, anemones, crabs, etc.) and refugia for free swimming fish and invertebrates. Therefore, this proposed alternative is consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resources Restoration and the Bird restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The proposed alternative has a clear nexus to spill injuries as it would help compensate for injuries to birds. More specifically, the breakwater and revetment construction and fill activities align with restoration techniques identified in the DWH Oil Spill Natural Resource Damage Assessment: Strategic Framework for Bird Restoration Activities (DWH Trustees 2017c). This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This proposed alternative would build upon preliminary engineering, alternatives analysis, and a 70% construction plan that was funded by the USFWS and the CEPRA. Because of the earlier performed feasibility study and E&D work, much of the uncertainty associated with the design has been reduced. Additionally, this design has been used at other nesting islands in Texas with considerable success. The proposed alternative has a high likelihood of being successful.
	Prevents future injury and avoids collateral injury: Aside from the potential for minor disturbances during construction, the proposed alternative is not expected to cause collateral injury to natural resources. All construction and installation activities would be restricted to the non-breeding season for birds, and the Implementing Trustee would use established protocols and methods to minimize collateral injury of protected resources and critical habitats. Aside from the potential for minor disturbances during construction, the proposed alternative is expected to cause minimal collateral injury to natural resources. The alternative would follow established BMPs to avoid and minimize collateral injury, including the National Marine Fisheries Service's (NMFS's) *Measures for Reducing Entrapment Risk to Protected Species* (NMFS 2012), *Vessel Strike Avoidance Measures (*NMFS 2021a), and *Protected Species Construction Conditions* (NMFS 2021b), and USACE *Standard Manatee Conditions for In-Water Work* (USACE 2011).
	Benefits multiple resources: The proposed alternative would benefit multiple resources including birds, invertebrates, nekton, seagrasses, hard aquatic substrate, and bird nesting habitat. Protecting the island from erosion is expected to benefit the seagrass beds in the long term by preventing continued deposition of shoreline material onto existing seagrasses. Similarly, existing oyster reefs in the project area would be expected to benefit from a net reduction in turbidity and the increase in hard substrate provided by construction of the breakwater system. General improvements in water quality as a result of the reduction in turbidity would be anticipated.
	Public health and safety: The final design of this proposed alternative would include specifications to avoid adverse impacts on public health and safety, including compliance with all USCG requirements. The alternative would provide long-term benefits to public health and safety by reducing the effects of erosion on water quality and improve overall coastal resiliency.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets Trustees goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.7.2 Jones Bay Oystercatcher Habitat Restoration

3.7.2.1 PROJECT DESCRIPTION

The Jones Bay Oystercatcher Habitat Restoration alternative would restore habitat to support American oystercatcher (*Haematopus palliates*) nesting and foraging habitat in Jones Bay, approximately 0.5 miles west of the community of Tiki Island in Galveston County (Figure 3-16). The project will restore a total of about one acre of nesting habitat on five small existing islands, create six intertidal reef sites totaling approximately 1.5 acres to support foraging needs, and up to a 300-foot breakwater. A total of $2,300,000 in funding would be provided under this proposed alternative; remaining funding for the total estimated project cost of $3,700,000 would come from other secured sources. The project would provide habitat to support eight additional nesting pairs of oystercatchers and their young. If selected by the Texas TIG in the Final RP/EA #2, this alternative would only be implemented if funding from other sources is secured so that the construction of all five islands, six reef sites, and one breakwater will be completed.

Over the last 10 years, the Gulf Coast Bird Observatory (GCBO) has monitored breeding populations of oystercatchers in various bays along the Texas coast. These monitoring efforts indicate a steep decline in reproductive success, due to a variety of circumstances including over wash where nests are flooded by high tide events. The American oystercatcher is listed as a species of conservation concern in conservation plans (Brown et al. 2001; USFWS 2021a) including the Texas Conservation Action Plan (TPWD 2012). Furthermore, the State of Texas has designated the species as vulnerable due to low population numbers and recent declines. This species was injured as a result of the DWH oil spill (DWH Trustees 2017c).

In Texas, oystercatchers nest primarily on small bay islands where disturbance and predation are low. These islands are also located near foraging areas associated with intertidal reefs. Over several decades, many of the island sites have suffered from erosion and have also decreased in elevation relative to the local mean tide levels. Nesting habitat that provides for successful reproduction is understood to be the primary threat facing breeding populations of American oystercatchers in Texas. Many of the once suitable islands in the Bay are now submerged. GCBO conducted an analysis of island size in Jones Bay from 2009 to 2015 and documented a decrease in nesting island size by up to 60% during this time (Hackney and Heath 2018). Following this analysis, further reductions have been dramatic, rendering three of the original six islands unsuitable for oystercatcher nesting (Hackney and Heath 2018). Additionally, the oystercatcher depends primarily on intertidal reef sites for its food (American Oystercatcher Working Group et al. 2012). Increased water levels associated with these sites have also forced nesting oystercatchers to venture farther for food as intertidal reefs become inaccessible to foraging birds. The number of breeding pairs that use Jones Bay has fallen sharply over the last decade (Hackney and Heath 2018).

Due to prior nesting success in Jones Bay, existing reefs in the bay, and its overall protected nature, this sub-bay was determined to be an appropriate target location for restoration. This alternative also builds upon the Jones Bay Oystercatcher Habitat Restoration & Enhancement project managed by the Galveston Bay Foundation. Non-NRDA funding of that project supported initial E&D and permitting, as well as future funding for construction of part of the restoration project. If this alternative is selected, the alternative would support completion of five nesting islands, six intertidal reef sites, and up to a 300-foot breakwater to protect an island site from vessel wave action.

Figure 3-16. Jones Bay Oystercatcher Habitat Restoration location map.

Construction activities would occur outside the nesting and brood rearing season for American oystercatchers or for any other bird species that are present. Design specifications for both the nesting islands and oyster reefs are based on existing reference sites in Jones Bay, nearby bays that exhibit successful oystercatcher nesting and abundant reef colonization and growth, and natural resource experts. Construction of the alternative would involve the following:

- Construction of five nesting islands totaling about 1 acre. Nesting island restoration would be achieved by placing approved cultch material on existing islands to increase their elevation so that the islands would be less susceptible to extreme overwash events, wave energies, and erosional forces. The elevation of nesting sites on existing small islands would be enhanced to elevations that exceed MHW using graded limestone to raise the elevation to approximately to +4.5 feet North American Vertical Datum of 1988 (NAVD88). A review of a nearby NOAA tide station indicates that this elevation should protect the nesting island from most high tide events during the nesting season. Cultch material would also be graded and sized to use larger grain material in high energy locations and to ensure the island remains stable over time.
- A 300-foot rock breakwater would be installed at one island site (Site 1) if needed to protect the nesting island from vessel wakes associated with the Gulf Intracoastal Waterway.
- Intertidal reef restoration would place cultch-acceptable material near each restored nesting island to provide foraging habitat for nesting oystercatchers and their young. The six reef sites would comprise a total area of about 1.5 acres. The intertidal reef would be constructed near each island and adjacent to existing reef using limestone cultch to enhance reef structure for eastern oysters, mussels and reef-dwelling fish and invertebrates. For the intertidal reef component of the project, geotextile fabric may be placed on the substrate to better support cultch material and reduce settlement. The reef would be constructed to an elevation of approximately +0.20 feet NAVD88 to ensure that it would be accessible the majority of the time to foraging oystercatchers.

Acceptable cultch material can be natural rock, clean concrete, and/or oyster shell to restore the nesting island and intertidal reef. Although oyster shell can be preferable for certain aspects of the project, limestone is a more functional alternative as it is more resilient in a marine environment and can be graded and sized to meet specific engineering requirements. Enhancement activities would involve the placement of loose, recycled oyster shell to improve oyster recruitment and foraging habitat. Secondary benefits include the creation of essential habitat necessary to support eastern oyster colonization, other bird species, and various species of fish and invertebrates. All oyster shell would be sourced from Galveston Bay Foundation's Oyster Shell Recycling Program. The shell would be properly sun-cured for a minimum of six months on land prior to being placed in Jones Bay. No temporary access channels would be required to facilitate construction access. All material moving equipment would be placed on top of shallow-draft barges to place the material at restoration sites. No pilings or rebar would be required to anchor the structures.

Resiliency, sea level rise, and other environmental factors would be considered prior to initiation of construction. Texas TIG anticipates that the alternative would be designed for a 20- to 25-year life span. The TGLO would be the Implementing Trustee for construction and DOI would be the Implementing Trustee for monitoring component of the project. The Galveston Bay Foundation, as the USACE permit applicant and state-owned-land lease holder, would be responsible for management of the restored islands and created reefs for the anticipated life span of the alternative through a lease with the TGLO.

The MAM plan for this proposed alternative is in Appendix A.

3.7.2.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Jones Bay Oystercatcher Habitat Restoration	**Cost-effectiveness:** The estimated cost of this proposed alternative is $2,300,000 to be funded from Bird restoration type dollars. This amount, combined with additional funding from other sources, would be used to fund the total estimated cost of $3,700,000 for the construction of 5 islands, six intertidal reef, and one breakwater. The Implementing Trustees and project partners deemed estimated costs to implement this alternative as reasonable, based on the type of work, project, and resources targeted for restoration. Costs are comparable to similar activities for other shallow water bird island and reef projects (such as the Cow Trap Bird Islands project constructed in Cow Trap Lake by USFWS and Ducks Unlimited). The alternative would only be implemented if sufficient funding is secured to construct all five islands, six reef sites, and up to a 300-foot breakwater.
	Goals and objectives: The proposed alternative would restore habitat to support American oystercatcher nesting and foraging habitat in Jones Bay, which is consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resources Restoration and the Bird restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The alternative has a clear nexus to injuries to birds caused by the oil spill, specifically American oystercatchers. The reef expansion activities align with restoration techniques identified in the DWH Oil Spill Natural Resource Damage Assessment: Strategic Framework for Bird Restoration Activities (DWH 2017c). This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative would support distinct restoration work within the context of an existing restoration effort. This alternative would implement methods that are well established and other projects (such as the Nueces Bay Rookery Islands Restoration funded by NFWF GEBF in 2014) of similar nature and scope have been implemented in Texas successfully.
	Prevents future injury and avoids collateral injury: Aside from the potential for minor disturbances during construction, the proposed alternative is not expected to cause collateral injury to natural resources. This alternative focuses on the restoration of previously used nesting islands, would create new intertidal reef area to enhance foraging opportunities, and construct one breakwater. All construction and installation activities would be restricted to the non-breeding period for birds where appropriate, using established protocols and methods to minimize collateral injury of protected resources and critical habitats. The alternative would follow established BMPs to avoid and minimize collateral injury, including NMFS's *Measures for Reducing Entrapment Risk to Protected Species* (NMFS 2012) *Vessel Strike Avoidance Measures* NMFS 2021a), and *Protected Species Construction Conditions* (NMFS 2021b), and the USACE's *Standard Manatee Conditions for In-Water Work* (USACE 2011).
	Benefits multiple resources: The primary benefit of this proposed alternative is to increase nesting and foraging habitat for American oystercatchers, a species of concern and one injured during the DWH spill by restoring nesting islands and creating intertidal reef. Jones Bay contains historical American oystercatcher nesting sites that are increasingly threatened by overwash and erosion. Ancillary benefits to other bird species and reef habitat would be expected. Improvements in the overall productivity of Jones Bay by increasing available cultch material for invertebrate and fish recruitment would encourage reef development. The proposed alternative would also enhance water quality and recreational opportunities for the surrounding communities.
	Public health and safety: The final design of this proposed alternative would include specifications to avoid negative impacts on public health and safety. The restored islands and placement of culch would comply with all safety requirements that may include notices to mariners, temporary lights on equipment and material barges, and standard safety practices.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets Trustees goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.7.3 San Antonio Bay Bird Island

3.7.3.1 PROJECT DESCRIPTION

The San Antonio Bay Bird Island alternative would create an up to 4-acre island in San Antonio Bay using coastal construction techniques to replace nesting habitat that was historically provided by Seadrift Rookery Island. This proposed alternative would be located approximately 500 feet north of the Seadrift Boat Channel and 300 feet east of the former Seadrift Rookery Island (Figure 3-17). A total of $1,500,000 in funding would be provided under this proposed alternative; remaining funding for the total estimated project cost of $6,000,000 would come from previous financial commitments from RW RP/EA #1 (RW TIG 2021) and other secured sources. Monitoring would be funded by the Texas TIG. Final design and construction would be prorated by funding source (specific percentages would depend on the percentage of funds each funding source provides). If selected by the Texas TIG in the Final RP/EA #2, this alternative would only be implemented if funding through other sources is secured so that the construction of an approximately 4-acre island can be implemented.

Nesting populations of colonial waterbirds have declined due to a lack of sufficient island nesting habitat. Human disturbance and predators have also been identified as factors in population declines. The primary recommendation to address these declines and increase colonial waterbird populations is to create or restore islands (Stanzel and Dodson 2014). Extensive wetlands surrounding San Antonio Bay provide suitable foraging grounds within a short flight distance from the island, ensuring a food source for the growth of chicks produced on the island. In particular, previous evaluations identified the area near Seadrift, Calhoun County as an optimal colonial waterbird island location (HDR 2016; Stanzel 2017). At one time, Seadrift Rookery Island was documented to support approximately 13% of colonial waterbirds nesting on in-bay colonies (excluding Chester Island) within the San Antonio Bay system (Stanzel and Dodson 2014). Likely affected waterbirds include brown pelicans, terns, and wading birds.

This alternative would include 1) completion of final E&D and preparation of a solicitation; 2) construction of the island; and 3) monitoring in accordance with a MAM plan over the course of no less than five years. The TGLO would be the Implementing Trustee for construction and DOI would be the Implementing Trustee for the monitoring component of the project. Once constructed, the island would be leased to CBBEP for future management activities.

The island would be located adjacent to Seadrift Rookery Island and would be designed to capture a full range of desired bird nesting and foraging habitats, which would mimic habitats previously observed on Seadrift Rookery Island. The island is anticipated to be oriented northwest to southeast based on predominant wind direction from the southeast. The island would be thinner than it is wide (~ 920 feet × 450 feet), which would create a gradual slope from the beach area to the upland area and would maximize acreage for each habitat type desired for the island. Although the area of the island above the waterline would be approximately four acres, the island would have a total bay bottom footprint closer to eight acres. The proposed location is situated in relatively shallow water, with firm bottom conditions capable of supporting island creation.

A protective berm would be constructed around the perimeter of the proposed island. This shoreline protection feature would contain fill material protected with armoring of stone, concrete or an acceptable substitute and reduces the overall construction footprint of the island. Fill material for placement within the berm would be obtained from an approved outside source, dredged material placement area, in situ bay location, or from sediments sourced from a nearby navigation project. The source of fill used for construction would be identified prior to the start of construction and chemically analyzed prior to ensure that no contaminants are present. Equipment, fill, and rock would be transported to the site via existing channels on barges. No new channels or dredging to access the site would be required.

A shallow water beach opening would be included at the northwestern side of the island. This gap is where a proposed reef would also be located. The reef would be constructed with graded riprap comprised of acceptable and approved materials. Project implementation may require avoidance of activities on the site during time periods based on resource concerns in the affected area (e.g., the avoidance of bird and sea turtle nesting season). Resiliency, sea level rise, and other environmental factors would be considered during E&D. Texas TIG anticipates that the alternative would be designed for a 20- to 25-year life span.

The MAM plan for this alternative is in Appendix A.

Figure 3-17. San Antonio Bay Bird Island location map.

3.7.3.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
San Antonio Bay Bird Island	**Cost-effectiveness:** The estimated cost of this proposed alternative is $1,500,000 to be funded from Bird restoration type dollars. This amount, combined with additional funding from other sources, would be used to fund the total estimated cost of $6,000,000 for the construction of the 4-acre island. The RP/EA #2 incorporates by reference findings made in the RW RP/EA #1 (RW TIG 2021), which determined that the proposed costs for the alternative are reasonable and appropriate, based on similar past projects and expert knowledge. This alternative is cost effective because it leverages other sources of funds and would only be implemented if sufficient funding is allocated so that the construction of an approximately 4-acre island can be implemented.
	Goals and objectives: The proposed alternative would create an up to 4-acre island in San Antonio Bay, which is consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resources Restoration and the Bird restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The alternative has a clear nexus to injuries, and it would help compensate for injuries to birds caused by the oil spill. The proposed alternative would construct a new island for nesting birds and aligns with restoration techniques identified in the DWH Oil Spill Natural Resource Damage Assessment: Strategic Framework for Bird Restoration Activities (DWH Trustees 2017c). This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: Per findings made in the RW RP/EA #1 (RW TIG 2021), the proposed alternative is technically feasible and likely to succeed based on past Implementing Trustee experience with similar types of projects. This alternative would implement methods that are well established and have been proven to be successful. Other rookery island projects constructed by Implementing Trustees and other project partners such as North Deer Island, Evia Island, Nueces Bay Islands, and Dickinson Bay Island I are similar in nature and scope and have been implemented successfully in Texas. The proposed alternative's location was selected based on historic presence of a rookery island, which is anticipated to increase the likelihood of bird use once construction is complete. Further, partial funding for implementation of the San Antonio Bay Bird Island alternative has already been selected in the RW RP/EA #1 (RW TIG 2021), which increases likelihood of project success.
	Prevents future injury and avoids collateral injury: Aside from the potential for minor disturbances during construction, the proposed alternative is not expected to cause substantial collateral injury to natural resources. The Implementing Trustee would use established protocols and methods to minimize collateral injury of protected resources and sensitive habitats. The alternative would follow established BMPs to avoid and minimize collateral injury, including NMFS's *Measures for Reducing Entrapment Risk to Protected Species* (NMFS 2012), *Vessel Strike Avoidance Measures (*NMFS 2021a), *Protected Species Construction Conditions* (NMFS 2021b), and the USACE's *Standard Manatee Conditions for In-Water Work* (USACE 2011.
	Benefits multiple resources: The primary benefit of this alternative would be the creation of bird nesting habitat in San Antonio Bay, an area that has experienced loss of nesting habitat. Increased availability of nesting habitat would benefit waterbird species injured by the spill. Ancillary benefits to other species that rely on these same habitat types are expected. Intertidal and subtidal hard substrate would be used by aquatic invertebrates and would provide interstitial space used by fish and free-swimming invertebrates for refugia. The proposed alternative would enhance recreational opportunities for the surrounding communities.
	Public health and safety: The Texas TIG does not anticipate adverse impacts to public health and safety from the implementation of this alternative. The final design of this proposed alternative would include specifications to avoid negative impacts on public health and safety. The new island would comply with all U.S. Coast Guard requirements, such as notices to mariners, temporary lights on equipment and material barges, and standard safety practices.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative meets Trustees goals and objectives, provides multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.7.4 Texas Breeding Shorebird and Seabird Stewardship

3.7.4.1 PROJECT DESCRIPTION

The Gulf of Mexico coastal region supports a diversity of coastal bird species throughout the year, as nesting grounds during breeding periods, as a stopover for migrating species in the spring and fall, and as wintering habitat for numerous species that breed elsewhere. The Texas Breeding Shorebird and Seabird Stewardship alternative would protect breeding bird habitat and reduce human disturbance to nesting shorebirds and other bird species during the nesting season along the Texas coast. Counties involved in this alternative would include, but may not be limited to, Galveston, Brazoria, Matagorda, Nueces, and Cameron Counties (Figure 3-18). The estimated total cost of this alternative is $3,400,000.

Stewardship activities would reduce the effects of disturbance and predation on nest success and chick survival through the use of intervention techniques (e.g., temporary fencing, nest patrols, etc.), which would facilitate improved nest production (i.e., more fledglings). These methods support additional recruitment into the population that would not take place otherwise (Dinsmore 2008; Foster et al. 2009). The increased recruitment would compensate for the birds lost or injured by the DWH oil spill. These intervention methods work by enhancing the production of individual birds at particular sites on an annual basis. Conditions at each site may change annually due to natural processes and when site managers must change plans to meet other resource or recreational goals. At the onset of the breeding season, birds may choose different areas to use for nesting based on these changes. Therefore, intervention methods must be seasonal, and the expected benefits would be accrued on an annual basis.

This alternative would include 1) project team development, 2) site selection and management, and 3) implementation of stewardship activities. The DOI would be the Implementing Trustee. The DOI would coordinate with the Texas TIG and RW TIG, and would work with potential project partners, to implement proposed activities.

A project team would be developed for the alternative and would include organizations that specialize and focus on bird conservation nationally, state-wide, and regionally and have established relationships with site managers along the coast. The project team would meet annually to review the previous season's data and adaptively manage and strategize activities for each site for the current season to best reach alternative goals and objectives. A partner organization would be contracted to work with the Implementing Trustee to coordinate the activities and reporting by the other team members. Sites and methods would be selected based on a variety of factors including focusing the effort on the most important sites where intervention would yield the greatest benefits to nesting birds.

At the onset of each year's breeding season, site managers would be made aware of the schedule and target goals identified in project team yearly meetings, and field staff would begin to identify nesting territories targeted for protection. The proposed alternative would include a combination of methods that include targeted outreach and education to site owners, managers, and the public on beaches; symbolic fencing in areas where such fencing is allowed; signage to protect high-use bird nesting areas; and steward patrols and collection of breeding bird and nesting success data at each designated site. Additional intervention methods may include predator-proof fencing (in areas where such fencing is allowed), live trapping, or other techniques specific to the predator threat. Each designated site would also be monitored to document activities that may affect reproductive success and help guide adaptive management. At the appropriate time, young and adult birds could be banded by a qualified bander holding U.S. Geological Survey banding permits, USFWS migratory bird permits, and TPWD scientific permits. Impacts to nesting habitat from vehicles, site management activities, and pedestrian traffic would be managed, to the extent allowed by law, by site managers to ensure human activities (such as wildlife viewing or other recreation opportunities) can continue while allowing nesting success of breeding birds. Additional activities could include holding events to engage visitors about nesting birds and to increase awareness, which may be stand-alone events or associated with larger events hosted by the site manager.

Site managers are voluntary participants interested in balancing natural resource needs with recreational needs. Site managers for the project would include city, county, state, and non-governmental organizations who are responsible for coastal sites that are used for natural resource conservation and public recreation. Relationships with most existing site managers have been established during previous stewardship efforts. However, new site managers could be added based on available resource allocations and site needs. The project team members would work closely with each site manager to develop approaches to accommodate the needs of breeding birds, public recreation, and site management operations.

It is anticipated that once a project team has been established, activities in preparation for the upcoming breeding season would begin annually in January. Depending on the species targeted and location of designated sites, field activities would be prepared for annually, including initial planning through field activities for the breeding season. The alternative would continue for at least five consecutive breeding seasons.

The MAM plan for this alternative is in Appendix A.

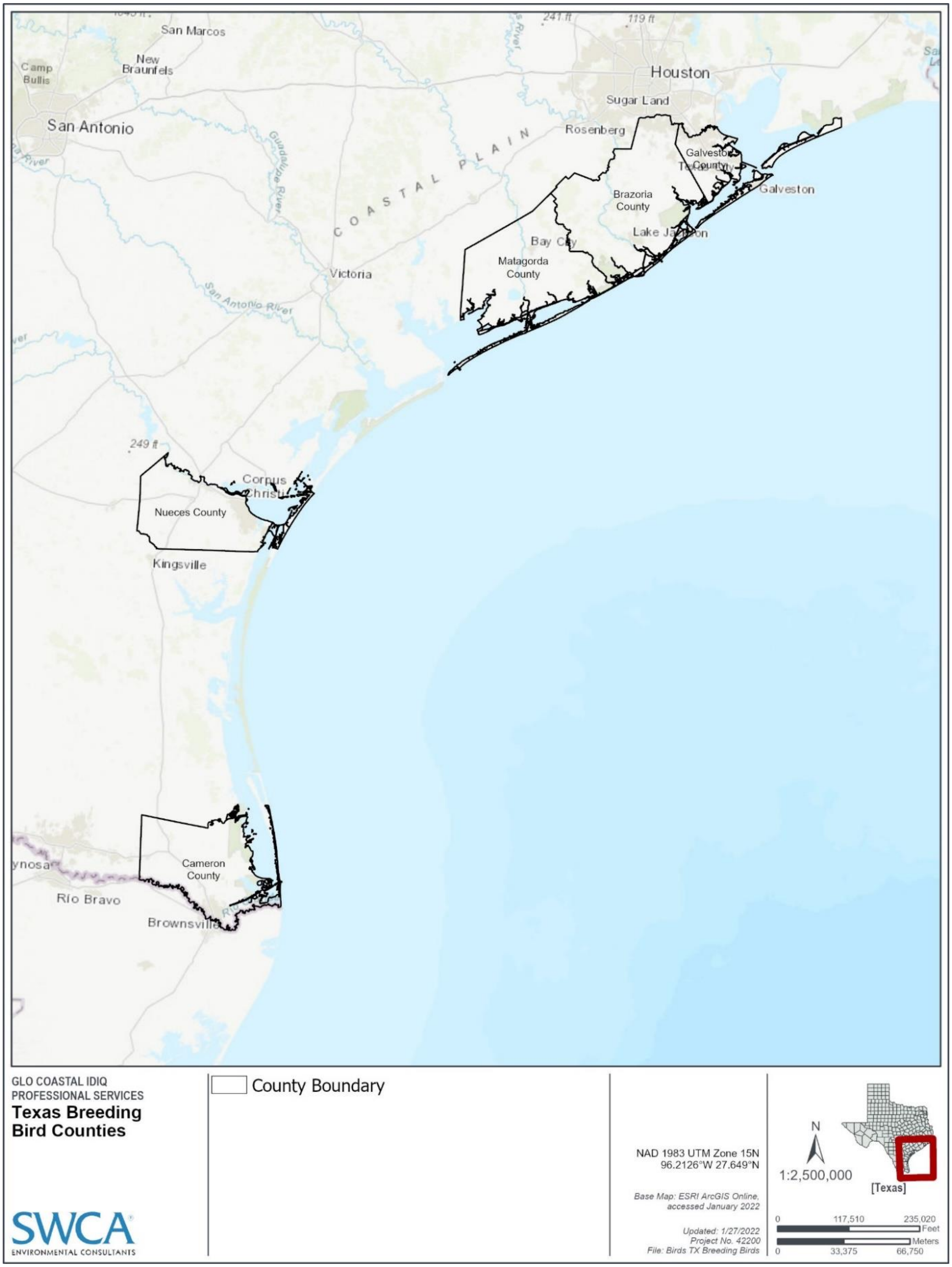

Figure 3-18. Texas Breeding Shorebird and Seabird Stewardship location map.

3.7.4.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Texas Breeding Shorebird and Seabird Stewardship	**Cost-effectiveness:** The estimated cost of this proposed alternative is $3,400,000 to be funded from Bird restoration type dollars. The RP/EA #2 incorporates by reference findings made in the RW RP/EA #1 (RW TIG 2021), which determined that the proposed costs for bird stewardship activities are reasonable and appropriate, based on similar past projects and expert knowledge. The costs to carry out this alternative to implement stewardship activities, purchase necessary equipment and materials, and conduct monitoring and oversight are comparable to the costs of similar stewardship activities on the Texas coast and are comparable to other bird stewardship projects evaluated in Alabama and Florida RP/EAs, such as Phase II Early Restoration – Enhanced Management of Avian Breeding Habitat Injured by Response Activities in the FL Panhandle (Portal ID #9, https://www.gulfspillrestoration.noaa.gov/project?id=9).
	Goals and objectives: This alternative would protect breeding bird habitat and reduce human disturbance to nesting shorebirds and other bird species, which is consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resources and the Bird restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The alternative has a clear nexus to injuries, and it would help compensate for losses to birds caused by the spill. Stewardship activities for breeding bird activities align with restoration techniques identified in the DWH Oil Spill Natural Resource Damage Assessment: Strategic Framework for Bird Restoration Activities (DWH Trustees 2017c).
	Likelihood of success: This alternative utilizes proven effective stewardship activities including reducing human disturbance, protecting and improving habitat quality, and improving regulatory coordination to restore shorebird and seabird populations. The alternative would be adaptively implemented based on shorebird nesting monitoring data. This type of activity has been employed successfully on the Texas coast since 2012 with a variety of partnerships (American Bird Conservancy 2020, 2019). Therefore, this alternative would have a high likelihood of success.
	Prevents future injury and avoids collateral injury: Aside from the potential for minor disturbances during implementation, the proposed alternative is not expected to cause collateral injury to natural resources. The main avenue through which injury to natural resources could potentially occur would be through intervention techniques (e.g., symbolic fencing, nest patrols, etc.). However, all activities would follow protocols and with the intent to reduce disturbance of bird nesting habitat.
	Benefits multiple resources: Through stewardship and conservation activities, this alternative seeks to increase reproductive success and population size for shorebird and seabird species injured as a result of the oil spill. This alternative would provide large-scale benefits to multiple species of shorebirds along the Texas Gulf, as well as ancillary benefits to other species that use the same coastal habitat (e.g., sea turtles or invertebrates). The proposed alternative would also maintain recreational opportunities for the surrounding communities.
	Public health and safety: The Texas TIG does not anticipate negative impacts to public health and safety as a result of this alternative. However, the Implementing Trustee would comply with, and ensure that all participants comply with, all relevant safety measures, practices, and regulations during implementation to maintain a safe, protective environment for those involved with the alternative.
	Summary: Based on the OPA analysis, this alternative is identified as a preferred alternative in the RP/EA #2. The cost is reasonable, the alternative has a high probability of success, the alternative would meet the Trustees goals and objectives, provide multiple resource benefits; and no substantive collateral injuries or adverse public health and safety impacts are anticipated.

3.7.5 Gulf Cut Bird Islands Restoration

3.7.5.1 PROJECT DESCRIPTION

The East Matagorda Bay Gulf Cut Islands are a complex of low islands in East Matagorda Bay approximately 33 miles east of Chester Island and eight miles west of Dressing Point Island. The islands in the complex are less than one mile from the Gulf Intracoastal Waterway (GIWW). The Gulf Cut Bird Islands Restoration alternative would restore approximately 0.86 acre of nesting habitat on four existing emergent shell islands for ground nesting waterbirds in East Matagorda Bay, Texas (Figure 3-19). These islands historically supported ground nesting colonial and solitary waterbirds. Wind and wave erosion and over wash frequency have increased over time, and the available nesting habitat has decreased over time.

The proposed restoration would raise the elevation of these islands so that nesting activities would not experience overwash events as frequently. The estimated total cost of this alternative is $13,000,000.

Enhancement of existing rookery islands would reduce the likelihood of a high tide events flooding out nesting birds during their breeding season. The designs used in this alternative would aim to protect against the most frequent over wash events, protect the restored islands from further degradation. Colonial and solitary nesting waterbirds that would benefit from this alternative include black skimmer (*Rynchops niger*), gull-billed tern (*Gelochelidon nilotica*), Forster's tern (*Sterna forsteri*), least tern (*Sternula antillarum*), Wilson's plover (*Charadrius wilsonia*), and American oystercatcher. Resiliency, sea level rise, and other environmental factors would be considered during engineering and design. The Texas TIG anticipates that the alternative would be designed for a 20- to 25-year life span.

This alternative builds upon the *Matagorda Bay Texas Rookery Island Feasibility Study and Alternatives Analysis* project that was conducted through a grant from the NFWF GEBF in 2015 (Freese and Nichols, Inc. 2018). Funding of that project provided initial site selection and E&D steps for one or more new colonial waterbird rookery islands in the Matagorda Bay area of the Texas coast.

This proposed alternative would include 1) planning, initial surveys, final E&D plans, environmental compliance reviews and permitting, and preparation of a solicitation package; 2) construction; and 3) monitoring activities. Construction would involve the placement of approximately 34,000 CY of limestone rock and cultch material on the current islands and within the surrounding shallow water. Placement of the material would avoid existing reef and seagrass habitat. Signs would be installed on the islands restricting public access during the nesting season. The DOI would be the Implementing Trustee, and would work with partners likely consisting of Audubon Texas, Matagorda Bay Foundation, GCBO, USFWS, and the Texas Colonial Waterbird Society.

Figure 3-19. Gulf Cut Bird Islands Restoration location map.

3.7.5.2 OPA NRDA EVALUATION

Alternative	OPA Evaluation
Gulf Cut Bird Islands Restoration	**Cost-effectiveness:** The estimated cost of this proposed alternative is $13,000,000 to be funded from Bird restoration type dollars. The cost for the alternative is higher when compared to similar past projects in Texas (such as those constructed by Texas Trustees in Nueces, Matagorda, and Galveston Bays). The proposed engineering design (Freese and Nichols, Inc. 2018) includes conditions that substantially elevate costs. The Texas TIG deemed the alternative as compared to other bird restoration alternatives considered in this document as not cost effective.
	Goals and objectives: This alternative would restore approximately 0.86 acre of nesting habitat on four existing emergent shell islands, which is consistent with the programmatic Trustee goal of Replenish and Protect Living Coastal and Marine Resources and the Bird restoration type goals in the Final PDARP/PEIS (DWH Trustees 2016a). The alternative has a clear nexus to injuries and would help compensate for injuries to birds resulting from the oil spill. The nesting island restoration activities align with restoration techniques identified in the DWH Oil Spill Natural Resource Damage Assessment: Strategic Framework for Bird Restoration Activities (DWH 2017c). This alternative is also consistent with Texas TIG goals and objectives.
	Likelihood of success: This alternative would restore nesting habitat on previously occupied islands using methods that are well established and have been proven to be successful. Other projects (such as the Nueces Bay Rookery Islands Restoration) of similar nature and scope have been implemented in Texas successfully. However, potential for long-term project partner support and site management are unknown. These uncertainties reduce the likelihood of success.
	Prevents future injury and avoids collateral injury: Aside from the potential for minor disturbances during construction, the proposed alternative is not expected to cause substantial collateral injury to natural resources. All construction and installation activities would be restricted to the non-breeding season for birds, and the Implementing Trustee would use established protocols and methods to minimize collateral injury of protected resources and critical habitats. The alternative would follow established BMPs to avoid and minimize collateral injury, including NMFS's *Measures for Reducing Entrapment Risk to Protected Species* (NMFS 2012), *Vessel Strike Avoidance Measures (*NMFS 2021a), *Protected Species Construction Conditions* (NMFS 2021b), and the USACE's *Standard Manatee Conditions for In-Water Work* (USACE 2011).
	Benefits multiple resources: The primary benefit of this alternative is the restoration of four former nesting islands in East Matagorda Bay, an area that has experienced loss of nesting habitat. Increased availability of nesting habitat would benefit seabird populations. Ancillary benefits to other bird species and oyster reef habitat are expected. The proposed alternative would enhance recreational opportunities (e.g., bird watching) for the surrounding communities.
	Public health and safety: The final design of this proposed alternative would include specifications to avoid adverse impacts on public health and safety. The restored islands and placement of culch would be sited and comply with all USCG requirements, such as notices to mariners, temporary lights on equipment and material barges, and standard safety practices.
	Summary: Based on the OPA analysis, this alternative was not identified as a preferred alternative at this time in the RP/EA #2. Although the alternative would meet Trustees goals and objectives and benefit multiple resources, it is more expensive than the other proposed alternatives in this document, and would produce substantially less habitat (only 0.86 acre). This alternative is not a preferred alternative at this time as compared to other alternatives considered in this restoration type.

3.8 Monitoring and Management of Projects

Trustees establish restoration objectives that are specific to the natural resources that were injured (15 CFR Section 990.55(b)(2)) and that clearly specify the desired outcome and the performance criteria by which successful restoration will be determined. These steps help the Trustees determine whether the restoration successfully meets the objectives under OPA (15 CFR Section 990.55(b)(2)). The monitoring component of a restoration plan is described in 15 C.F.R. Section 990.55(b)(3). As described in Chapter 5, Appendix E of the PDARP/PEIS, the DWH Trustees committed to a MAM Framework that incorporates the best available science into planning and design of the alternative; identifies and reduces key uncertainties; tracks and evaluates progress toward restoration goals; and determines the need for corrective actions (DWH Trustees 2017a). The MAM Framework provides a flexible, science-based approach to implement and monitor restoration.

The Texas TIG developed draft MAM plans for each of the preferred alternatives identified in this RP/EA #2 (Appendix A) that include implementation. Generally, these MAM plans outline the monitoring needed to evaluate each alternative's progress toward meeting objectives, describe appropriate corrective actions, and acknowledge the need to address adaptive management. Specifically, the MAM plans define project goals and objectives; identify key uncertainties; set out monitoring parameters and schedules; and describe potential corrective actions. The plans included in Appendix A are consistent with the requirements and guidelines set forth in the PDARP/PEIS (DWH Trustees 2016a), the Trustee Council SOPs (Trustee Council SOP August 2021), and the Trustees' MAM Manual (DWH Trustees 2021). The MAM plans are living documents and are intended to be updated to incorporate new information as it becomes available or as needed to reflect changing conditions. For example, if additional information indicates that the sampling design for the alternative is inadequate, or if new uncertainties are identified during implementation and monitoring of the alternative, the plan may need to be revised. Updates to MAM plans and any additional details concerning the status of monitoring would be made publicly available through the Texas Restoration Area Gulf Spill Restoration website (https://www.gulfspillrestoration.noaa.gov/restoration-areas/texas).

3.9 Best Management Practices (BMPs)

As part of the environmental compliance process, federal regulatory agencies provide guidance on BMPs such as lessons learned, expert advice, and tips from the field. DWH Trustees incorporate appropriate BMPs into planning and design of the preferred alternatives to avoid or minimize impacts on natural resources, such as protected and listed species and their habitats. BMPs are identified in required permits, consultation letters, or environmental reviews, including those described in Appendix 6.A of the PDARP/PEIS (DWH Trustees 2016a).

3.10 OPA NRDA Evaluation Conclusions

The Texas TIG completed its OPA NRDA evaluation of the reasonable range of alternatives, determined by the screening criteria discussed in Section 2. In total, 18 alternatives were evaluated. Projects within the reasonable range fall into two categories: preferred and not preferred. While all projects are evaluated under the OPA NRDA evaluation in this chapter and the NEPA analyses presented below in Chapter 4, the TIG would implement only those alternatives selected in the Final RP/EA #2. Based on the results of these analyses, the Texas TIG proposes to proceed with the implementation of 13 preferred alternatives (see Table 1-2). The analysis indicates that each of these 13 preferred alternatives would provide benefits to its associated restoration type. The preferred alternatives would be cost-effective, meet Texas TIG goals and objectives, have a high likelihood of success, would not have or would adequately prevent collateral injury, would have minimal impacts or would improve public health and safety, and would benefit multiple resources.

The one preferred E&D alternative (Petronila Creek Constructed Wetlands Planning) is intended to generate information necessary to determine the feasibility of designing and implementing potential future conservation activities by converting a 240-acre agricultural tract to constructed wetlands. This alternative would not directly restore natural resources or their services but would provide information needed to evaluate whether the project can effectively reduce nutrient load in coastal water and would fund a design that will most effectively achieve a reduction.

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CHAPTER 4 ENVIRONMENTAL ASSESSMENT

This section describes the affected environment and details anticipated environmental impacts for all proposed alternatives. Analysis was conducted to be consistent with Council on Environmental Quality (CEQ) NEPA regulations, revised as of September 2020.

Impacts were assessed in accordance with the impact definitions in the Final PDARP/PEIS; (DWH Trustees 2016a: Table 6.3-2, Appendix A), wherein impacts are characterized as adverse or beneficial. Adverse impacts are designated as *minor*, *moderate*, or *major* and *short term* or *long term*. Beneficial impacts are only characterized as short term or long term. *Adverse* is used in the RP/EA #2 only to describe the Texas TIG's evaluation under NEPA. That term is defined and applied differently in consultations conducted pursuant to the ESA and other protected resource statutes. Accordingly, adverse impacts may be identified under NEPA; however, this does not necessarily mean that an action would be likely to adversely affect the same species because that term is defined and applied under protected resources statutes. The results of any completed protected resource consultations are included in the DWH administrative record.

4.1 Resources Evaluated for Further Analysis

The Texas TIG determined that certain resource areas are likely to be unaffected or not measurably affected by the restoration actions being proposed in the RP/EA #2. Table 4-1 identifies which resources were carried forward for further analysis under each restoration type. Where a resource was determined not to be carried forward for detailed analysis, rationale is provided.

Table 4-1. Resources Evaluated for Further Analysis by Restoration Type

Resource	Wetlands, Coastal, and Nearshore Habitats Alternatives	Nutrient Reduction Alternatives	Oysters Alternatives	Sea Turtle Alternatives	Birds Alternatives
Physical Resources – Geology and Substrates	Carried forward for detailed analysis for **Bird Island Cove Habitat Restoration Project - Construction** and **Bahia Grande Channel F Hydrologic Restoration** alternatives. Habitat acquisition alternatives would not result in ground-disturbing activities that could impact geology and substrates.	All proposed alternatives (excluding E&D only) carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.
Physical Resources – Hydrology and Water Quality	Carried forward for detailed analysis for **Bird Island Cove Habitat Restoration Project - Construction** and **Bahia Grande Channel F Hydrologic Restoration** alternatives. Habitat acquisition alternatives would not result in ground-disturbing activities that could impact hydrology and water quality.	All proposed alternatives (excluding E&D only) carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	Carried forward for detailed analysis for all alternatives excluding the **Kemp's Ridley Sea Turtle Nest Protection** alternative, which would not result in ground-disturbing activities that could impact hydrology and water quality.	All proposed alternatives carried forward for detailed analysis excluding the **Texas Breeding Shorebird and Seabird Stewardship** alternative, which would not result in ground-disturbing activities that could impact hydrology and water quality.
Physical Resources – Air Quality	Carried forward for detailed analysis for **Bird Island Cove Habitat Restoration Project - Construction** and **Bahia Grande Channel F Hydrologic Restoration** alternatives. Habitat acquisition alternatives would not result in adverse impacts to air quality as no new emission-producing activities would be anticipated.	All proposed alternatives (excluding E&D only) carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	Carried forward for detailed analysis for all alternatives excluding the **Texas Breeding Shorebird and Seabird Stewardship** alternative. Actions associated with this alternative would not result in measurable air emissions.

Resource	Wetlands, Coastal, and Nearshore Habitats Alternatives	Nutrient Reduction Alternatives	Oysters Alternatives	Sea Turtle Alternatives	Birds Alternatives
Physical Resources – Noise	Carried forward for detailed analysis for **Bird Island Cove Habitat Restoration Project - Construction** and **Bahia Grande Channel F Hydrologic Restoration** alternatives. Habitat acquisition alternatives would not result in adverse impacts to noise as no new noise-producing activities would be anticipated beyond existing ambient noise levels.	Noise produced from implementation activities would be typical of existing farmstead operations (e.g., plowing, harvesting, small earthmoving activities, land clearing). No measurable change in ambient noise levels is anticipated. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	Carried forward for detailed analysis for all alternatives excluding the **Texas Breeding Shorebird and Seabird Stewardship** alternative. Actions associated with this alternative would not result in a measurable change in ambient noise levels.
Biological Resources – Habitats	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives (excluding E&D only) carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.
Biological Resources – Wildlife Species	All proposed alternatives carried forward for detailed analysis.	No adverse impacts to wildlife individuals, birds, and migratory birds are anticipated as a result of implementation of these alternatives as actions would be similar to typical farmstead operations (e.g., plowing, harvesting, small earthmoving activities, land clearing). Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	All proposed alternatives carried forward for detailed analysis.	Carried forward for detailed analysis for the **Upper Texas Coast Sea Turtle Rehabilitation Facility** and the **Lancha Sea Turtle Mitigation Plan** alternatives. There would be no habitat disturbance associated with all the remaining sea turtle alternative.	All proposed alternatives carried forward for detailed analysis.
Biological Resources – Marine and Estuarine Resources	All proposed alternatives carried forward for detailed analysis.	There would be no in-water marine work or work adjacent to estuarine habitats associated with nutrient reduction alternatives. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	All proposed alternatives carried forward for detailed analysis.	Carried forward for detailed analysis for the **Lancha Sea Turtle Mitigation Plan**. There would be no in-water marine or estuarine work associated with all other sea turtle alternatives.	All proposed alternatives carried forward for detailed analysis excluding the **Texas Breeding Shorebird and Seabird Stewardship**, which would not result in ground-disturbing activities that could impact marine and estuarine species.

Resource	Wetlands, Coastal, and Nearshore Habitats Alternatives	Nutrient Reduction Alternatives	Oysters Alternatives	Sea Turtle Alternatives	Birds Alternatives
Biological Resources – Protected Species	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives (excluding E&D only) carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.
Socioeconomic Resources – Cultural Resources	Carried forward for detailed analysis for **Bird Island Cove Habitat Restoration Project - Construction** and **Bahia Grande Channel F Hydrologic Restoration** alternatives. Habitat acquisition alternatives would not result in ground-disturbing activities that could adversely impact cultural resources.	All proposed alternatives (excluding E&D only) carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	Carried forward for detailed analysis for **Upper Texas Coast Sea Turtle Rehabilitation Facility**. All other sea turtle alternatives would not include new construction, excavation, or alteration of existing structures. As such, these activities would have little to no potential to impact cultural resources.	Carried forward for detailed analysis for all alternatives, excluding the **Texas Breeding Shorebird and Seabird Stewardship**. Stewardship activities would entail limited to no new ground disturbance, so the potential for impacts to cultural resources was deemed negligible.
Socioeconomic Resources – Socioeconomics and Environmental Justice	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives (excluding E&D only) carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.
Socioeconomic Resources – Tourism and Recreation	Carried forward for detailed analysis for all alternatives excluding **Bahia Grande Channel F Hydrologic Restoration** alternative, which would not provide public access.	Nutrient reduction alternatives would be carried out on private land. Private land does not provide tourism and recreational benefits. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	All proposed alternatives carried forward for detailed analysis.	Carried forward for detailed analysis for **Lancha Sea Turtle Mitigation Plan and Kemp's Ridley Sea Turtle Nest Protection** alternatives. Construction of the **Upper Texas Coast Sea Turtle Rehabilitation Facility** would not impact tourism and recreation as the current site is unavailable for recreational use.	All proposed alternatives carried forward for detailed analysis.

Resource	Wetlands, Coastal, and Nearshore Habitats Alternatives	Nutrient Reduction Alternatives	Oysters Alternatives	Sea Turtle Alternatives	Birds Alternatives
Socioeconomic Resources – Aesthetics and Visual Resources	All proposed alternatives carried forward for detailed analysis.	Conservation practices would be consistent with current farming practices, and the creation of vegetated berms would be consistent with the existing visual landscape and would not result in visual contrast. There would be no change in the overall aesthetic that would attract attention or dominate existing views. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	All proposed alternatives carried forward for detailed analysis.	Carried forward for detailed analysis for **Upper Texas Coast Sea Turtle Rehabilitation Facility**. All other sea turtle alternatives would not result in construction or modifications to existing landscapes. Patrolling and nest monitoring activities would be consistent with existing activities in the area and would not result in land or marine use changes that could affect aesthetics.	All proposed alternatives carried forward for detailed analysis.
Socioeconomic Resources – Infrastructure	All proposed alternatives carried forward for detailed analysis.	None of the alternatives would create increased demands that could not be accommodated by existing infrastructure or would measurably affect vehicle or vessel traffic and transportation in the alternatives' vicinity. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	All proposed alternatives carried forward for detailed analysis.	None of the alternatives would create increased demands that could not be accommodated by existing infrastructure or would measurably affect vehicle or vessel traffic and transportation in the alternatives' vicinity. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	Carried forward for detailed analysis for all alternatives, excluding the **Texas Breeding Shorebird and Seabird Stewardship.** Stewardship activities would not increase demands on existing infrastructure or measurably affect vehicle or vessel traffic and transportation in the alternative's vicinity.

Resource	Wetlands, Coastal, and Nearshore Habitats Alternatives	Nutrient Reduction Alternatives	Oysters Alternatives	Sea Turtle Alternatives	Birds Alternatives
Socioeconomic Resources – Fisheries and Aquaculture	All proposed alternatives carried forward for detailed analysis.	Nutrient reduction alternatives would affect onshore parcels that do not coincide with any commercial fishing or aquaculture operations. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	All proposed alternatives carried forward for detailed analysis for fisheries. Based on best available data, oyster alternatives do not coincide with any aquaculture operations.	Fisheries was carried forward for detailed analysis for **Lancha Sea Turtle Mitigation Plan**. All other alternatives would occur inland or on coastal beaches that do not coincide with fisheries and aquaculture activities. Based on best available data, sea turtle alternatives do not coincide with any aquaculture operations.	Carried forward for detailed analysis for commercial fishing for all alternatives, excluding the **Texas Breeding Shorebird and Seabird Stewardship.** Stewardship activities occur inland or on coastal beaches that do not coincide with fisheries and aquaculture activities. Based on best available data, bird alternatives do not coincide with any aquaculture operations.
Socioeconomic Resources – Marine Transportation	Carried forward for detailed analysis for **Bird Island Cove Habitat Restoration Project - Construction**. All other alternatives would affect onshore parcels that do not coincide with marine transportation.	Nutrient reduction alternatives would affect onshore parcels that do not coincide with marine transportation activities. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	All proposed alternatives carried forward for detailed analysis.	The sea turtle alternatives do not involve construction activities in marine areas. These alternatives would introduce a negligible amount of local daily marine traffic volumes, resulting in potential perceived inconvenience to operators but no actual disruptions to transportation. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	Carried forward for detailed analysis for all alternatives, excluding the **Texas Breeding Shorebird and Seabird Stewardship.** Stewardship activities would not coincide with marine transportation activities.

Resource	Wetlands, Coastal, and Nearshore Habitats Alternatives	Nutrient Reduction Alternatives	Oysters Alternatives	Sea Turtle Alternatives	Birds Alternatives
Socioeconomic Resources – Land and Marine Management	Carried forward for detailed analysis for **Habitat Acquisition** alternatives. All other alternatives would be consistent with the prevailing management, practices, plans, and direction governing the use of the areas where restoration actions would take place.	Nutrient reduction alternatives would not change any existing or planned land uses or property ownership and would be consistent with the prevailing management, practices, plans, and direction governing the use of the areas where the restoration actions would take place. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	The oyster alternatives would be consistent with the prevailing management, practices, plans, and direction governing the use of the areas where the oyster reef restorations would take place. The specific sites for oyster reef restoration would be determined as part of the site-suitability analysis, which would include a review of applicable Resource Management Codes. Therefore, the oyster alternatives are anticipated to have no impact to land and marine management.	The sea turtle alternatives would be consistent with the prevailing management, practices, plans, and direction governing the use of the areas where restoration actions would take place. Therefore, this resource was not carried forward for detailed analysis for any of the proposed alternatives.	The bird alternatives would involve construction activities along shorelines and in state-owned submerged areas. Appropriate TGLO Coastal Surface Leases or modifications to existing leases would be acquired prior to project initiation to allow for construction activities within state-owned submerged lands. Therefore, the bird alternatives are anticipated to have no impact to land and marine management.
Socioeconomic Resources – Public Health and Safety	All proposed alternatives carried forward for detailed analysis.	All proposed alternatives (excluding E&D only) carried forward for detailed analysis.	All proposed alternatives carried forward for detailed analysis.	Carried forward for detailed analysis for **Upper Texas Coast Sea Turtle Rehabilitation Facility**. All other sea turtle alternatives would represent a continuation of ongoing enforcement and vehicle activity, and any changes to public health and safety over current operations would be negligible.	Carried forward for detailed analysis for all alternatives, excluding the **Texas Breeding Shorebird and Seabird Stewardship.** Stewardship activities would represent a continuation of ongoing activity, and any changes to public health and safety over current operations would be negligible.

4.2 Affected Environment

This section describes the existing physical, biological, and socioeconomic environment of the 18 alternatives considered in the RP/EA #2. Resources specific to a particular project or project type are described in further detail in Section 4.3 below. As displayed on Figure 1-1 in Section 1.6, all alternatives are situated along the Texas Gulf Coast, encompassing 17 Texas counties and offshore coastal waters.

This section also incorporates by reference affected environment information from the Final PDARP/PEIS (DWH Trustees 2016a), and RW RP/EA #1, as well as the *Coastal Texas Protection and Ecosystem Restoration Feasibility Study: Final Environmental Impact Statement* (USACE and TGLO 2021). The Texas TIG reviewed and determined that this information remains relevant to the current NEPA analysis. This incorporated material is summarized in Sections 4.2.1 to 4.2.3, as applicable.

4.2.1 Physical Resources

4.2.1.1 GEOLOGY AND SUBSTRATES

The Gulf Coast is generally overlain by a smooth coastal plain that decreases in thickness from inland to the coastline. Land surface elevations in the coastal counties of Texas range from 0 to 250 feet above sea level (Chowdhury and Turco 2006). Moving seaward from the coastline, the northern Gulf of Mexico is characterized by broad geomorphological zones, including the coastal transition zone, the continental shelf, the continental slope, and the abyssal plain. The majority of alternatives proposed under the RP/EA #2 take place in the coastal transition zone, which is characterized by bays, estuaries, wetlands, and barrier islands (RW TIG 2021). Surficial geology and sediment along the Gulf Coast of Texas consists primarily of fluvial deposits from major rivers and streams originating from the Miocene and Pleistocene periods. Sea level changes and subsidence over time resulted in discontinuous pockets of sand, silt, clay, and gravel. The majority of sediment deposits along the central and western coasts of the Gulf of Mexico originate from the Mississippi/Atchafalaya River Basins, supplemented by other major Texas rivers such as the Colorado, Sabine, Neches, Trinity, and Brazos Rivers, which contribute sediments to the nearshore waters, estuaries, and bay systems (Chowdhury and Turco 2006). Sediment deposition is influenced by wave action, wind, river flows, and tidal currents. Within the coastal transition zone, wave and tidal action play a greater role in sediment transport and therefore affect the deposition patterns and chemical compositions of substrates in intertidal benthic habitats (RW TIG 2021). In the northern Gulf of Mexico, benthic substrates are most commonly soft bottom, consisting of sand, clay, silt, or mud, which become progressively finer from inland to offshore as sediments are deposited differentially by grain size. Hard substrates, including artificial reefs, oil and gas platforms, and natural reef or rock substrates, account for approximately 4% of the total area of the marine benthic habitat and can occur both nearshore and offshore (DWH Trustees 2016a).

4.2.1.2 HYDROLOGY AND WATER QUALITY

As stated in the RW RP/EA #1, incorporated herein by reference, over 60% of the continental United States ultimately drains to the Gulf of Mexico via an extensive network of lakes, rivers, freshwater springs, and streams, with more than 90% of the freshwater inflow originating from the Mississippi and Atchafalaya River Basins. At a regional scale, freshwater inflow originating from the San Jacinto, Brazos, Trinity, Colorado, Sabine, Neches, Guadalupe, and Nueces Rivers and their tributaries has a more direct influence upon coastal Texas waters. Other major tributaries within the areas of interest for the RP/EA #2 include (from northeast to southwest): Oyster Bayou, Cane Bayou, East Fork Double Bayou, Old River, Cedar Bayou, Whites Bayou, Turtle Bayou, Buffalo Bayou, Clear Creek, Dickinson Bayou, Halls Bayou, Chocolate Bayou, Mustang Bayou, Austin Bayou, Oyster Creek, the San Bernard River, Caney Creek, Live Oak Bayou, Jones Creek, the Tres Palacios River, Coleto Creek, the San Antonio River, Copano Creek, Mission River, Petronila Creek, Agua Dulce Creek (a direct tributary of Petronila Creek), Chiltipin Creek, San Fernando Creek, Jaboncillos Creek, Salado Creek, Los Olmos Creek, Palo Blanco Creek, Laguna Madre, La Sal Vieja, Arroyo Colorado, and the Laguna Atacosta. Freshwater inflow influences the location, size, frequency, and variety of estuarine and nearshore habitats, especially during the spring rainy season. The inflow of freshwater from these rivers mixes with saline Gulf of Mexico waters, creating an extensive variety of biologically rich estuarine and offshore habitats. The nearshore coastal environment is characterized as a relatively shallow, open coastline with complex circulation patterns, weak tidal energies, generally warm water temperatures, seasonally varying stratification strength, and large inputs of freshwater. Many of these coastal habitats rely heavily upon sediment deposits from upstream runoff to maintain their natural processes and prevent deterioration. Human modifications throughout the Gulf of Mexico watershed have affected the volume and variation of surface water flow entering the Gulf and reduced the amount of sediment being deposited into coastal wetlands and estuaries (RW TIG 2021).

In addition to valuable sediments, freshwater inflows also transport pollutants from agriculture, stormwater runoff, industrial activities, and wastewater discharges that adversely affect downstream water quality. Pollutants can include excess nutrients (e.g., nitrogen, phosphorus) and contaminants such as metals, oil and grease, suspended solids, wastewater, and biocides. Nutrient runoff from nonpoint sources associated with pasture/grassland and cropland (e.g., land application of livestock manure and/or commercial fertilizer, wildlife populations, feral hog populations, livestock grazing, or hunting camps) can adversely affect the health of coastal waters. Excessive nutrient enrichment, or eutrophication, of Gulf Coast estuaries and their watersheds is a chronic threat that can lead to hypoxia (low oxygen levels), harmful algal blooms, habitat loss, and fish kills (NOAA 2021c). Oil and gas exploration, natural seeps, and pesticides also contribute to hypoxia. Livestock operations and sewage facilities also contribute fecal coliform bacteria into receiving waters. Because estuaries and other nearshore environments are generally shielded from strong tidal and wave energies and are relatively shallow (rarely more than 500 to 650 feet deep) compared to the open ocean (thousands of feet deep), nutrients and pollutants tend to reach higher concentrations and take longer to dissipate in these habitats (RW TIG 2021).

In accordance with Sections 305(b) and 303(d) of the CWA, TCEQ is responsible for developing and enforcing the Texas Surface Water Quality Standards to ensure that both freshwater and marine surface waters in the state support their designated uses (i.e., aquatic life, contact and non-contact recreation, drinking water, oyster waters). Impairment criteria include dissolved oxygen, temperature, pH, dissolved minerals, toxic substances, and bacteria. Surface waters that do not meet the standards necessary to allow their designated uses must be included in the biennial 303(d) list of impaired waters, and TCEQ must calculate a TMDL for each impaired water. The TMDL establishes the maximum amount of a pollutant allowed in a waterbody and serves as the starting point or planning tool for restoring water quality. TCEQ manages point and nonpoint source discharges of pollutants to these waters by issuing permits under the Texas Pollutant Discharge Elimination System (USACE and TGLO 2021). Any activity that would result in discharges of pollutants to an impaired water would be subject to review and permitting under the Texas Pollutant Discharge Elimination System. Major surface waters designated as impaired in the vicinity of the proposed alternatives are as follows (TCEQ 2021a):

- Gulf Intracoastal Waterway
- Galveston Bay (including Trinity, Upper and Lower Galveston, East and West Bays)
- Offatts Bayou
- Chocolate Bay
- Bastrop Bay/Oyster Lake
- Drum Bay
- Oyster Creek Tidal
- San Bernard River Tidal
- Caney Creek Tidal
- East Matagorda Bay
- San Antonio Bay/Hynes Bay/Guadalupe Bay/Mission Lake (Oyster Waters)
- Copano Bay/Port Bay/Mission Bay (Oyster Waters)
- Laguna Madre
- Petronila Creek
- Port Isabel Fishing Harbor

4.2.1.3 AIR QUALITY

Pursuant to the Clean Air Act (CAA), as last amended in 1990, the EPA has set National Ambient Air Quality Standards (NAAQS) for six principal criteria air pollutants (i.e., ground-level ozone, lead, carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter) that are known to be harmful to public health, especially sensitive populations such as children, the elderly, and individuals with certain health conditions (EPA 2021b). Areas that do not meet these standards for one or more criteria pollutants are designated as nonattainment areas. The CAA requires states to submit state implementation plans (SIPs) for all nonattainment areas to outline the measures to be taken to improve air quality and to demonstrate progress toward meeting the NAAQS. Federal actions that take place within nonattainment areas may be subject to general conformity requirements to ensure that the action conforms with the SIP and would not cause or contribute to exceedances of the NAAQS. However, projects that are expected to result in *de minimis* levels of emissions (40 CFR Section 93.153) are generally exempt from conformity requirements (TCEQ 2021b).

Brazoria, Chambers, and Galveston Counties are within the Houston-Galveston-Brazoria area, which has been designated as a serious nonattainment area for ozone (EPA 2021a). Ozone is generated primarily from emissions of volatile organic compounds and nitrous oxides from nonpoint sources (i.e., vehicles, area sources, agriculture) and stationary or point sources (e.g., power plants, industrial activities, etc.) (EPA 2021a). The Corpus Christi area, including San Patricio and Nueces Counties, is designated by TCEQ as an ozone near-nonattainment area (i.e., currently in attainment but in danger of exceeding compliance with the NAAQS in the future). An 8-hour Ozone Flex Plan has been adopted for this area that includes voluntary measures that employers and citizens can implement to reduce ozone emissions (TCEQ 2007b). No other nonattainment or maintenance areas for any criteria pollutants are present within the 17-county region containing all considered alternatives.

In addition to the six criteria pollutants in the NAAQS, greenhouse gases (GHGs) are chemical compounds found in the Earth's atmosphere that absorb and trap infrared radiation as heat. The principal GHGs emitted to the atmosphere through human activities are carbon dioxide, methane, nitrous oxide, and fluorinated gases, such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride; carbon dioxide accounts for the largest quantity of GHGs emitted. Criteria air pollutants and GHG emissions are largely generated by electricity production, vehicular movements, and commercial and residential buildings using electricity. An analysis of regional climate impacts prepared by the Fourth National Climate Assessment (Kloesel et al. 2018) notes that "along the Texas coastline, sea levels have risen 5–17 inches over the last 100 years, depending on local topography and subsidence." Projected climate trends indicate that increasingly higher temperatures over time across the Southern Plains will exacerbate risks and impacts associated with severe weather events and sea level rise along the Texas coast. Per the assessment, sea level rise of twice the global average (estimated at 1–4 feet by 2100) is projected along the Texas Gulf Coast.

4.2.1.4 NOISE

Noise is generally defined as loud, unpleasant, unexpected, or undesired sound that is typically associated with human activity and that interferes with or disrupts normal activities. Although prolonged exposure to high noise levels has been demonstrated to cause hearing loss, the principal human response to environmental noise is annoyance. The response of individuals to similar noise events is diverse and influenced by the type of noise, the perceived importance of the noise and its appropriateness in the setting, the time of day and the type of activity during which the noise occurs, and the sensitivity of the individual.

As stated in Chapter 6 of the Final PDARP/PEIS, the primary sources of terrestrial noise in the coastal environment are transportation- and construction-related activities. In the marine environment, sounds are also introduced from marine transportation, military activities, energy development, and mineral-related activities (e.g., oil and gas exploration, drilling, and production), among others (DWH Trustees 2016a). Primary sources of ambient noise in or adjacent to the 17-county region containing all considered alternatives would be humans, vehicles, recreational boating and commercial vessels, and natural sounds from wildlife or coastal winds. Noise levels would vary depending on the season, time of day, number and types of noise sources, and distance from the noise source (DWH Trustees 2016a). Noise levels are also dependent on location, specifically coastal versus farther inland and rural versus urbanized areas.

4.2.2 Biological Resources

4.2.2.1 HABITATS

Texas has approximately 365 miles of open Gulf shoreline and 2,361 miles of bay-estuary lagoon shoreline. This is the most biologically rich and ecologically diverse region in the state and supports more than 601,000 acres of fresh, brackish, and salt marshes (TPWD 2012).

Texas is generally divided into 10 natural ecoregions, and the Gulf Coast is within the Gulf Prairies and Marshes Ecoregion. According to TPWD, this ecoregion is characterized as a nearly level, slowly drained plain less than 150 feet in elevation, dissected by streams and rivers flowing into the Gulf of Mexico (TPWD 2021a). Major rivers in the region consist of the San Jacinto, Trinity, Brazos, Nueces, and San Antonio. This region includes barrier islands along the coast, salt grass marshes surrounding bays and estuaries, remnant tallgrass prairies, oak parklands and oak mottes scattered along the coast, and tall woodlands in the river bottomlands (TPWD 2021a). Rainfall occurs throughout the year. The growing season is usually more than 300 days, with high humidity and warm temperatures. Native vegetation consists of tallgrass prairies and live oak woodlands. Brush species such as mesquite and acacias are more common now than in the past (TPWD 2021a).

Much of the natural habitats in the upland area of this ecoregion has been converted to agriculture and a suburban/urban landscape. Within these agricultural lands, little native vegetation is present, and disturbed areas often support noxious and invasive weeds.

Figure 4-1 shows a general cross section of subhabitats in this ecoregion. Salt marshes line the landward side of Texas's inner coastal bays. Coastal bays include tidal mudflats, shallow bays, seagrass beds, and hypersaline (salty) lagoons. Along the Texas coast, human-made jetties have been built to protect shipping channels from sedimentation. The area between land and deeper Gulf waters are known as nearshore waters. These naturally support soft sand and mud substrates, but this area also includes human-made reefs.

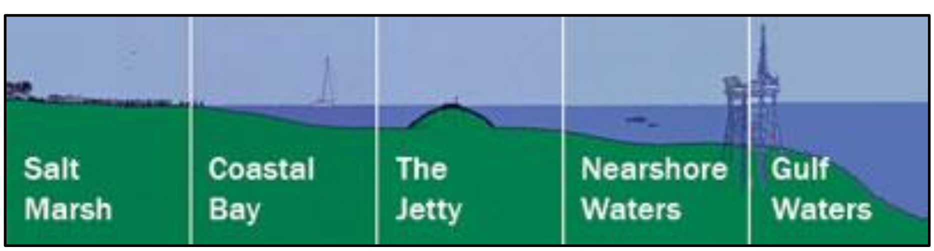

Figure 4-1. Gulf subhabitat cross-section (TPWD 2021b).

Coastal marshes in Texas can be divided into two major ecosystems: the Chenier Plain Ecosystem, from the Texas-Louisiana border to East Bay (Texas), and the Texas Barrier Island Ecosystem, from Galveston East Bay to the Texas-Mexico border (TPWD 2012). Plants and animals present in these habitats tolerate changes in water level and salinity. Marshes function as biological filters where pollutants from freshwater runoff can settle out before reaching the Gulf (TPWD 2021c). Per the Texas Conservation Action Plan, "Salt marshes are typically dominated by cordgrass, although black mangrove (*Avicennia germinans*) predominates in certain areas. Salt marshes are subject to intermittent inundation due to tidal action and high levels of freshwater inflow" (TPWD 2012).

Saline and brackish marshes are most widely distributed south of Galveston Bay, while brackish marshes are the most extensive marsh type east of Galveston Bay (TPWD 2012). The lower Texas Gulf Coast has only a narrow band of emergent marsh but has a system of extensive bays and lagoons. Coastal wetlands serve as nursery grounds for shrimp species and many recreational and commercially important fish species found in the Gulf; provide breeding, nesting, and feeding grounds for many wildlife species; and provide permanent and seasonal habitat for a great variety of wildlife.

As noted above, southern coastal bays include tidal mudflats, shallow bays, and lagoons. Tidal mudflats are large flat expanses of mud that are barely under water even at high tide. These areas support populations of worms, clams, crabs, and shrimp that provide a food source for shorebirds and other wildlife. These coastal bays support large beds of seagrasses, which are a unique habitat in many Texas bays and estuaries. Seagrass beds provide nursery habitat for estuarine species, are a major source of organic biomass for coastal food webs, are effective natural agents for stabilizing coastal erosion and sedimentation, and are major biological agents in nutrient cycling and water quality processes. They form some of the most productive communities in the world. Because seagrasses are sensitive to nutrient enrichment, water quality problems, and physical disturbance, distribution of seagrasses is used as an indicator of the health of an environment.

Nearshore waters in the Texas Gulf are mostly soft mud or sand. Open bays, such as the areas around Galveston Bay, are shallow bays with soft bottoms but no seagrass beds. These areas are nutrient rich and important feeding areas for young fish and shrimp. Since the 1940s, TPWD has been placing artificial reefs in nearshore waters. The hard, upright surfaces of artificial reefs in the otherwise flat-bottomed nearshore waters provide a secure anchor for wildlife such as barnacles, oysters, mussels, sponges, and corals (TPWD 2021e).

4.2.2.2 WILDLIFE SPECIES

As discussed in the Habitats section above, the Texas Gulf Coast is an ecologically complex and biologically diverse region capable of supporting a wide diversity of wildlife and birds. Agricultural, prairie, and woodland habitats support numerous terrestrial species of mammals, amphibians, and reptiles. Common species include coyote (*Canus latrans*), nine-banded armadillo (*Dasypus novmcinctus*), white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), squirrel (*Sciurus* spp.), and cottontail rabbit (*Sylvilagus* spp.). Freshwater wetlands and rivers support species such as muskrat (*Ondatra zibethicus*), marsh rice rat (*Oryzomys palustris*), mink (*Neovison vison*), North American river otter (*Lontra canadensis*), American alligator (*Alligator mississippiensis*), diamond back terrapin (*Malaclemys terrapin*), and bull frog (*Lithobates catesbeianus*). Non-native wildlife in the analysis area that are considered nuisance species include nutria (*Myocastor coypus*) and wild boar (*Sus scrofa*).

Habitats in the region also provide suitable breeding, nesting, feeding, foraging, resting, and/or roosting habitat for birds. Millions of migrating birds such as geese, ducks, and songbirds find a winter home on the Texas Gulf Coast. The Texas Gulf Coast is part of the Central Flyway, a major migratory corridor between South America and Canada. Migratory birds include neotropical (long-distance) and temperate (short-distance) migrants, as well as resident species. These groups include wading birds (e.g., egrets and herons), shorebirds (e.g., sandpipers and plovers), seabirds (e.g., gulls and terns), marsh birds (e.g., rails and coots), waterfowl (e.g., ducks and geese), and land birds, which include raptors (e.g., eagles, hawks, falcons, and owls) and numerous passerines (e.g., sparrows, warblers, flycatchers, jays, and wrens). Several important wildlife sanctuaries and refuges are located in the region, including refuges for the endangered Attwater's greater prairie-chicken (*Tympanuchus cupido attwateri*) and the whooping crane (*Grus americana*).

The Migratory Bird Treaty Act (MBTA) is the primary legislation in the United States that protects migratory birds. The statute makes it unlawful without a waiver to pursue, hunt, take, capture, kill, or sell the parts, nests, or eggs of migratory birds. Non-native bird species, such as European starling (*Sturnus vulgaris*) and house sparrow (*Passer domesticus*), are not covered under the MBTA. Another statute, the Bald and Golden Eagle Protection Act of 1940 (BGEPA), further protects bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) within the United States. In addition to similar protections afforded migratory birds, the BGEPA protects eagles from disturbance and human-induced alterations that may impact nesting areas. Of these two species, only the bald eagle is known to breed and winter along the Texas Gulf Coast.

4.2.2.3 MARINE AND ESTUARINE RESOURCES (FISH, SHELLFISH, BENTHIC ORGANISMS)

Marine and estuarine aquatic fauna and fishery resources are protected under the Fish and Wildlife Coordination Act of 1958, as amended; the ESA; the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (Magnuson-Stevens Act); the Magnuson-Stevens Act Reauthorization of 2006; the Coastal Zone Management Act; and the Estuary Protection Act.

The Gulf of Mexico supports diverse assemblages of marine and estuarine fauna that inhabit freshwater, estuarine, coastal, and marine habitats, such as estuarine emergent wetlands (e.g., marsh edge, inner marsh, marsh ponds, and tidal creeks); seagrasses; mud, sand, shell, and rock substrates (e.g., oyster reefs, barrier island flats); and the estuarine water column.

Representative species that use marine and estuarine habitats include resident and migratory fishes, crustaceans, mollusks, and benthic invertebrates. In general, aquatic species assemblages can be grouped by habitat use and vary based on salinity, temperature, depth, and substrate. Many aquatic species will move between different habitat areas based on their life stage. For example, many pelagic (water-column-dwelling) and demersal (seabed-dwelling) fish depend on estuaries during their early life stages but will move to more open waters in adulthood. Diadromous fish species will migrate between saltwater and freshwater, either spending their adult life in saltwater but spawning in freshwater (anadromous) or the reverse (catadromous). "Nearshore benthic communities in the northern Gulf of Mexico are largely composed of macroinvertebrate groups such as mollusks, crustacea, sponges, and polychaetes" (RW TIG 2021).

Pelagic fish in the Gulf of Mexico inhabit open water environments and occur at varying depths within the water column depending on their life stage and resource availability. Examples of pelagic fish found in the Gulf of Mexico include king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), cobia (*Rachycentron canadum*), Atlantic yellowfin tuna (*Thunnus albacares*), Atlantic wahoo (*Acanthocybium solandri*), and herrings (*Clupeiformes*).

Demersal fish in the Gulf of Mexico are generally characterized as either soft-bottom or hard-bottom fish. Soft-bottom habitat includes fine grain sediments, mud, and sand, which provides less structure for aquatic organisms and therefore has lower species diversity than hard-bottom habitat, which includes exposed rock or substrata such as coral and clay, oyster reefs, or artificial structures and is more structurally complex. Soft-bottom fish found in the Gulf of Mexico include Atlantic bumper (*Chloroscombrus chrysurus*), sand perch (*Diplectrum formosum*), silver jenny (*Eucinostomus gula*), dusky flounder (*Syacium papillosum*), pigfish (*Orthopristis chrysoptera*), porgies (*Sparidae*), sea robins (*Triglidae*), batfish (*Ogcocephalidae*), left eye flounders (*Paralichthyidae*), cusk-eels (*Ophidiidae*) scorpionfishes (*Scorpaenidae*), jacks (*Carangidae*), and flounders (*Pleuronectiformes*) (RW TIG 2021). Hard-bottom fish found in the Gulf of Mexico include snappers (*Lutjanus* spp.), groupers (*Serranidae*), tilefishes (*Malacanthidae*), jacks, gray triggerfish (*Balistes capriscus*), and hogfish (*Bodianus* spp.) (RW TIG 2021).

Many estuarine and coastal wetlands in the Gulf of Mexico coastal region have been designated as one or more types of essential fish habitat (EFH) for federally managed fishery species under provisions of the Magnuson-Stevens Act. EFH for federally managed species includes all types of aquatic habitat that a species requires to spawn, breed, feed, or grow to maturity. Additionally, the NMFS manages highly migratory species (e.g., sharks) for which EFH is identified by geographical area rather than habitat type (RW TIG 2021). Federally managed fishery species having EFH within the region containing all considered alternatives are outlined in Table 4-2.

Table 4-2. Federally Managed Fishery Species and EFH Categories

Fishery Species/Management Unit	EFH Categories
White shrimp (*Penaeus setiferus*)	Emergent marsh, sand/shell bottom, soft bottom
Brown shrimp (*Penaeus aztecus*)	Emergent marsh, sand/shell bottom, soft bottom
Pink shrimp (*Penaeus duorarum*)	Sand/Shell bottom
Royal red shrimp (*Pleoticus robustus*)	Shelf edge/slope, soft bottom, sand/shell bottom, and reefs
Red drum (*Sciaenops ocellatus*)	Emergent marsh, sand/shell bottom, soft bottom
Reef fish (triggerfishes, jacks, wrasses, snappers, tilefish, groupers)	Shelf edge/slope, hard-bottom, reefs, sand/shell bottom, soft bottom
Coastal migratory pelagics (mackerels)	Nearshore and offshore waters
Finetooth shark (*Carcharhinus isodon*)	Estuarine and nearshore waters
Scalloped hammerhead shark (*Sphyrna lewini*)	Estuarine and nearshore waters
Bonnethead shark (*Sphyrna tiburo*)	Estuarine and nearshore waters
Blacknose shark (*Carcharhinus acronotus*)	Nearshore waters
Blacktip shark (*Carcharhinus limbatus*)	Estuarine and nearshore waters
Bull shark (*Carcharhinus leucas*)	Estuarine and nearshore waters
Atlantic sharpnose shark (*Rhizoprionodon terraenovae*)	Estuarine and nearshore waters
Spinner shark (*Carcharhinus brevipinna*)	Estuarine and nearshore waters
Lemon shark (*Negaprion brevirostris*)	Estuarine and nearshore waters

Source: Gulf of Mexico Fishery Management Council and National Oceanic and Atmospheric Administration (2016).

4.2.2.4 PROTECTED SPECIES

Protected species consist of designated wildlife and plant species that are protected from harm or harassment by law. The ESA of 1973 protects all federally listed wildlife and plant species, and the designated critical habitat of these species, in the United States. The ESA requires that federal agencies ensure that any action authorized, funded, or carried out by an agency is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. Other protected species include marine mammals such as the common bottlenose dolphin (*Tursiops truncatus*), protected by the Marine Mammal Protection Act of 1972 (MMPA), and migratory birds, protected by the MBTA and BGEPA. The primary regulatory agencies responsible for ESA compliance are the USFWS and NMFS.

A list of species listed as threatened or endangered that may occur within the region containing all considered alternatives, including a description of designated critical habitat as applicable, is included in Table 4-3 (USWFS 2021b). Critical habitat is defined as an area containing the physical or biological features essential to a listed species' conservation. Any action authorized, funded, or carried out by a federal agency is prohibited from destroying or adversely modifying designated critical habitat.

Table 4-3. List of Federally Protected Species and Critical Habitat under the Endangered Species Act

Common Name	ScientificName	FederalStatus*	Counties	Habitat Description†
Birds				
Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	E	Aransas, Galveston, Refugio, Victoria	Only found on the coastal prairie of Texas. Occurs in open coastal prairie grassland habitat with less than 25% shrub cover and a variety of grass heights available. Short grass (> 10 inches) areas are used for courtship and feedings; mid-height grass (10–16 inches) areas are used for roosting and feeding; and tall grass areas (16–24 inches) are used for nesting. No critical habitat has been designated for this species.
Eastern black rail	*Laterallus jamaicensis* ssp. *jamaicensis*	T	Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Harris, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, San Patricio	Occurs in shallow wetlands areas, in both salt and freshwater marshes. No critical habitat has been designated for this species.
Northern aplomado falcon	*Falco femoralis septentrionalis*	E	Aransas, Calhoun, Cameron, Kenedy, Kleberg, Matagorda, Nueces, Refugio, Willacy	Occurs in open grassland or savannah habitat with scattered trees or shrubs. No critical habitat has been designated for this species.

Common Name	ScientificName	FederalStatus*	Counties	Habitat Description[†]
Piping plover	*Charadriusmelodus*	T	Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Harris, Jackson, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Victoria, Willacy	Winters on intertidal beaches with sand and/or mudflats with no or very sparse vegetation. Critical habitat was originally designated in July 2001 and revised in June 2009 and includes beach habitat, interior bays, inlets, and lagoons along the Gulf Coast that provide important plover wintering grounds (USFWS 2009). Critical habitat for wintering piping plovers is designated in Aransas, Brazoria, Calhoun, Cameron, Galveston, Kenedy, Kleberg, Matagorda, Neuces, San Patricio, and Willacy Counties (USFWS 2021b).
Red knot	*Calidris canutus rufa*	T	Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Harris, Jackson, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Victoria, Willacy	Winters on coastal mudflats and tidal zones, and sometimes on open sandy beaches. Nests on inland arctic tundra on high and barren areas near a pond or stream. On July 15, 2021, the USFWS proposed to designated critical habitat across 13 states, including Texas, for the red knot. Proposed critical habitat is focused on maintaining natural stretches of beaches and coastal habitats, and includes occupied migration and wintering areas where red knot is known to occur. Proposed critical habitat for wintering red knot in Texas islocated in Galveston, Matagorda, Nueces,Kleberg, Kenedy, Cameron and Willacy Counties (USFWS 2021b).
Whooping crane	*Grus americana*	E	Aransas, Brazoria, Calhoun, Jackson, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Victoria	Rare bird species that overwinters in the Aransas National Wildlife Refuge, using approximately 22,500 acres of marsh and salt flat habitat (TPWD 2021f), and other areas in coastal Texas, Louisiana, and Florida. Migrates to central Canada to nest in swampy coniferous forests near lakes and ponds and will spend the summer in muskeg, prairie pools, and marsh habitats. Critical habitat was designated in June 1978 in the Aransas National Wildlife Refuge and vicinity in Aransas, Calhoun, and Refugio Counties (USFWS 1978, 2021b).
Fish				
Oceanic whitetip shark	*Carcharhinus longimanus*	T	Marine, offshore waters	Pelagic shark species that occurs in offshore open ocean, outer continental shelf, and deep water areas around oceanic islands. Typically found in the upper part of the water column in warm waters above 20 degrees Celsius (°C). No critical habitat has been designated for this species.

Common Name	ScientificName	FederalStatus*	Counties	Habitat Description†
Giant manta ray	*Manta birostris*	T	Marine, offshore waters	Typically occurs in offshore oceanic waters and productive coastal areas but is also found in estuarine waters, oceanic inlets, and within bays and intercoastal waterways. Typically found in cool waters ranging regionally from 19°C to 30°C. No critical habitat has been designated for this species.
Mammals				
Gulf Coast jaguarundi	*Herpailurus* (=Felis) *yagouaroundi cacomitli*	E	Aransas, Calhoun, Cameron, Kenedy, Kleberg, Nueces, Refugio, San Patricio, Willacy	Has not been observed in Texas since 1986. Found in dense, thorny, low brush such as spiny hackberry, lotebush, and blackbrush. No critical habitat has been designated for this species.
Ocelot	Leopardus (=Felis) pardalis	E	Aransas, Cameron, Kenedy, Kleberg, Nueces, Refugio, San Patricio, Willacy	Found in dense, thorny, low brush such as spiny hackberry, lotebush, and blackbrush. No critical habitat has been designated for this species.
West Indian manatee	*Trichechusmanatus*	T	Aransas County, Brazoria, Calhoun, Cameron, Chambers, Galveston, Harris, Jackson, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Willacy	Found in freshwater and saltwater habitat of canals, creeks, lagoons, or rivers in areas with access to natural springs or warm water (in winter) and areas with vascular plants and freshwater sources. No critical habitat has been designated for this species.
Fin whale	*Balaenoptera physalus*	E	Marine, offshore waters	Found in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes, and less commonly in the tropics. Usually occurs year-round in a wide range oflatitudes and longitudes, but the density of individuals in any one area changes seasonally. No critical habitat has been designated for this species.
Sei whale	*Balaenoptera borealis*	E	Marine, offshore waters	Prefers subtropical to subpolar waters on the continental shelf edge and slope worldwide. Usually observed in deeper waters of oceanicareas far from the coastline. No critical habitat has been designated for this species.
Sperm whale	*Physeter macrocephalus*	E	Marine, offshore waters	Found in areas with a water depth of 1,968 feet (600 m) or more and are uncommon in waters less than 984 feet (300 m) deep. No critical habitat has been designated for this species.
Rice’s whale	*Balaenoptera ricei*	E	Marine, offshore waters	Resident baleen whale found in the Gulf of Mexico along the continental shelf break between 100 and 400 meters in depth. No critical habitat has been designated for this species.

Common Name	**ScientificName**	**FederalStatus***	**Counties**	**Habitat Description†**
Reptiles				
Green sea turtle	*Chelonia mydas*	T	Marine, offshore waters, Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Willacy	Found worldwide in subtropical and temperate marine habitats. Inhabits shallow waters with abundant seagrass and algae. Nesting occurs on mainland beaches and islands where seawater temperature is greater than 77 degrees Fahrenheit (°F). Critical habitat was designated by the National Marine Fisheries Service (NMFS) for green sea turtle in September 1998, however no green sea turtle critical habitat occurs in Texas.
Hawksbill sea turtle	*Eretmochelys imbricata*	E	Marine, offshore waters, Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Willacy	Found in warm bays and shallow portions of oceans, such as seagrass beds and estuaries.Nesting occurs on mainland beaches and islands. Critical habitat was designated by NMFS for hawksbill sea turtle in September 1998, however no hawksbill sea turtle critical habitat occurs in Texas.
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	Marine, offshore waters, Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Willacy	Found in warm bays and coastal waters, such as seagrass beds, tidal rivers, and estuaries. Nesting occurs on mainland sandy coastal beaches. No critical habitat has been designated for this species.
Leatherback sea turtle	*Dermochelys coriacea*	E	Marine, offshore waters, offshore waters, Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Willacy	Found in open ocean and deeper waters of the Gulf and coastal bays. Nesting occurs on coastal beaches and barrier islands. Critical habitat for leatherback sea turtle was designated by NMFS in January 2012, however no leatherback sea turtle critical habitat occurs in Texas.
Loggerhead sea turtle	*Caretta*	T	Marine, offshore waters, Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Refugio, San Patricio, Willacy	At different life stages, this species can be found in coastal waters, including estuaries, and deep ocean. Nesting occurs primarily on ocean beaches and occasionally on estuarine beacheswith coarse-grained sands. Critical habitat for loggerhead sea turtle was designated by NMFS in July 2014. Critical habitat for this species includes marine Sargassum habitat only along the 10 m depth contour off of the coast of Texas, to the Gulf of Mexico-Atlantic border.

Common Name	ScientificName	FederalStatus*	Counties	Habitat Description†
Flowering Plants				
Black lace cactus	*Echinocereus reichenbachii* var. *albertii*	E	Kleberg, Refugio	Occurs in coastal grasslands and openings in dense scrublands and woodlands along the Gulf Coastal Plain. No critical habitat has been designated for this species.
Slender rush-pea	*Hoffmannseggia tenella*	E	Kleberg, Nueces	Occurs in openings amongst mesquite and other woody plants that have invaded shortgrass coastal prairie remnants. No critical habitat has been designated for this species.
South Texas ambrosia	*Ambrosia cheiranthifolia*	E	Cameron, Kleberg, Nueces	Occurs in grasslands and mesquite shrublands of the Texas Coastal Plain. No critical habitat has been designated for this species.
Texas ayenia	*Ayenia limitaris*	E	Cameron, Willacy	Occurs on well-drained soils in subtropical thorny woodlands and tall shrublands of the Rio Grande delta. No critical habitat has been designated for this species.

* USFWS Status Definitions:

E = endangered. Endangered species are those in imminent jeopardy of extinction. The ESA specifically prohibits the take of a species listed as endangered. Take is defined by the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

T = threatened. Threatened species are those in imminent jeopardy of becoming endangered. The ESA prohibits the take of a species listed as threatened under Section 4d of the ESA. Take is defined by the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

† Range or habitat information is from Audubon Field Guide Online, TPWD, the USFWS, and/or NOAA.

4.2.3 Socioeconomic Resources

4.2.3.1 CULTURAL RESOURCES

NEPA recognizes that a unique characteristic of an environment is its relation to historic or cultural resources. However, under NEPA, no definition is provided for “cultural resources.” The NRHP, which was established under the National Historic Preservation Act of 1966, as amended (NHPA) (54 USC Section 3001 et seq.), identifies historic properties based on their relationship to significant historic events or individuals, important stylistic or engineering trends, or in their potential to provide information about the local, regional, or national past (36 CFR Section 60[a–d]). Historic properties may include archaeological sites, historic structures, historic districts, landscapes, battlefields, or shipwrecks. Also included are Traditional Cultural Properties, which may be defined as locations that are eligible for the NRHP due to their association with practices or beliefs of a modern community that are tied to a community’s sense of history, place, or identity (Parker and King 1998).

Under Section 106 of the NHPA, agencies are required to attempt to identify, in coordination with other interested parties, including State Historic Preservation Officers (SHPOs) and federally recognized Native American tribal groups, whether historic properties are present within the area of effect of an undertaking and whether they would be significantly impacted by that undertaking. Projects which are directed, overseen, funded, partially funded, or permitted by a federal agency are considered undertakings.

In addition to NEPA and NHPA, other laws that may be involved in the protection of cultural and historic resources include the following:

- Antiquities Code of Texas (Texas Natural Resource Code Section 9:191) establishes State Antiquities Landmarks, provides for protection for prehistoric and historic archaeological sites on all state-owned lands (including submerged lands), and requires state agencies and political subdivisions of the state to coordinate with the Texas Historical Commission (THC) for ground-disturbing projects on state lands.
- Recorded Texas Historic Landmarks (Texas Government Code: Section 442) are structures identified as significant in Texas history. Impacts to the exterior of such structures may be reviewed by the THC.
- Texas Cemetery Protections (Texas Health and Safety Code: 711; Texas Administrative Code: Section 22) protects interments and burial furniture, including unmarked or previously unknown cemeteries, from disturbance.
- Abandoned Shipwreck Act of 1987 (43 USC Section 2101–2106) establishes federal ownership (and state custodianship) for shipwrecks located within navigable waters of each state.
- American Indian Religious Freedom Act (42 USC Section 1996) requires that federal actions do not impede the free use or access to Native American religious sites and protects Native American religious practice.
- Antiquities Act of 1906 (54 USC Section 320301–320303 and 18 USC Section 1866[b]) provides for presidential designation of national monuments and provides protection from excavation of those sites unless authorized by a permit.
- Archaeological and Historic Preservation Act of 1974 (16 USC Section 469–469c) requires the preservation of historic and archaeological data that might be destroyed by federal construction projects or other federally licensed activities or programs and establishes treatment programs for the care of archaeological collections.
- Archaeological Resources Protection Act (16 USC Section 470aa–mm) prevents the excavation, damage, or defacement of archaeological sites on federal or native land without permission from the land management agency and makes illegal the sale of artifacts recovered from federal property.
- Historic Sites Act of 1935 (54 USC Section 320101) allows the establishment and protection of National Historic Landmarks (which are also protected under the NHPA).
- Native American Graves Protection and Repatriation Act (25 USC Section 3001–3013) protects cultural objects (Native American remains, funerary goods, sacred objects, or objects of cultural patrimony) to which modern native groups can show lineal descent or cultural affiliation, when they are in control of a federal land management agency or museum controlling agency.
- Sunken Military Craft Act (10 USC Section 113 note) protects the wrecks of U.S. and foreign navy craft within U.S. waters.
- Executive Order (EO) 13007 stipulates that all federal land management agencies must attempt to accommodate access to Native American sacred sites and to avoid adversely affecting the physical integrity of such sites.

Texas has had a human presence for at least 11,000 years, at which point the coastline lay far offshore from its current location because the seawaters were trapped in the ice sheets of the Wisconsin Glaciation. Archaeological sites, including scatters of projectile points and bone, have been identified in offshore deposits off the Texas coast. Sea levels stabilized close to their current levels approximately 6,000 years ago. Since that time, the coastal margin has been continuously occupied by humans who have left their marks, including scatters of stone and shell tools, pottery, mounds of spent shells, hearths, and sometimes, their own bodies. At the time of European contact, the coast was occupied by a number of related native groups generally identified as the Karankawa. East of Galveston Bay, Atakapan-speaking groups predominated. Álvar Nuñez Cabeza de Vaca, a survivor of the Narváez expedition, was likely the first European to document the Texas coast in 1528. Variously claimed by Spain, France, Mexico, the Republic of Texas, and lastly, the United States, the Texas coast served as a vital corridor for commerce as well as an access point to the interior. Thus, the coastal zone is home to some of the earliest and densest colonial and early historical occupations, including missions, presidios, plantations, battlefields, and shipwrecks.

4.2.3.2 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

This section discusses existing community characteristics that are relevant for evaluating the alternatives. These community characteristics consist of demographics (including communities with environmental justice concerns), employment, and income/poverty status within the socioeconomic analysis area. County-level data are compared to information for the state of Texas for context. Information in this section was obtained from the U.S. Census Bureau 2015–2019 American Community Survey 5-year Estimates (U.S. Census Bureau 2019a, 2019b).

The RP/EA #2 analyzes alternatives spanning 17 Gulf Coast counties from Jefferson County (east of Houston) to Cameron County (at the Mexican Border). The demographic and economic characteristics of each county and the State of Texas is shown in Table 4-4. The counties that make up the analysis area for this document greatly vary in terms of population size and demographics, from rural Kenedy County to the heavily populated Houston Metropolitical Statistical Area, which contains Harris, Brazoria, Galveston, and Chambers Counties.

Table 4-4. Demographics and Economic Characteristics

Area	Population	Percentage Minority Population*	Percentage Population below Poverty Level*	Percentage Unemployed	Per Capita Income
Texas	28,260,856	58.0%	14.7%	5.1%	$31,277
Aransas County	24,462	32.6%	21.3%	7.5%	$30,863
Brazoria County	360,677	52.8%	8.7%	4.4%	$34,561
Calhoun County	21,668	57.7%	13.7%	5.5%	$27,268
Cameron County	421,666	91.0%	28.9%	5.8%	$17,430
Chambers County	41,305	33.0%	12.1%	5.6%	$35,916
Galveston County	332,885	42.6%	12.4%	6.2%	$36,819
Harris County	4,646,630	70.4%	15.7%	5.8%	$32,765
Jackson County	14,816	41.5%	14.7%	5.1%	$31,277
Jefferson County	254,340	59.4%	17.7%	4.9%	$27,094
Kenedy County	568	94.7%	5.5%	0.0%	$15,211
Kleberg County	30,974	79.8%	27.2%	8.5%	$22,646
Matagorda County	36,774	56.4%	18.9%	5.8%	$25,172
Nueces County	361,540	70.5%	16.6%	5.7%	$27,740
Refugio County	7,145	58.4%	16.5%	6.9%	$24,248

Area	Population	Percentage Minority Population*	Percentage Population below Poverty Level*	Percentage Unemployed	Per Capita Income
San Patricio County	67,008	61.6%	13.6%	4.4%	$32,267
Victoria County	92,109	55.3%	12.7%	2.8%	$27,178
Willacy County	21,588	88.8%	27.0%	13.8%	$14,888

Source: U.S. Census Bureau (2019a, 2019b).
* Shading indicates presence of low-income or minority population.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which was augmented by EO 14008 (Tackling the Climate Crisis), requires that federal agencies advance environmental justice by pursuing fair treatment and meaningful involvement of minority and low-income populations. Fair treatment means such groups should not bear a disproportionately high share of negative environmental consequences from federal programs, policies, decisions, or operations. Meaningful involvement means that federal officials actively promote opportunities for public participation and that federal decisions can be materially affected by participating groups and individuals.

Identification and analysis of communities with environmental justice concerns followed EPA's (2016) *Promising Practices for EJ Methodologies in NEPA Reviews*. Minority populations were identified using the Fifty-Percent analysis to initially identify the extent to which minority populations reside within the analysis area. Based on Table 4-4, 13 counties have minority populations that meet or exceed 50% of the total population. These 13 counties were then evaluated using the Meaningfully Greater analysis to determine whether that minority population exceeds a reference threshold. For the purposes of this analysis, any county containing a minority population percentage at least 10% higher than the state average was identified as containing a minority population. This step identified a total of six counties which are highlighted in column 3 in Table 4-4.

Low-income populations were identified using the Low-Income Threshold Criteria analysis. This analysis compared the proportion of individuals below the poverty level in project counties to state poverty level percentages. Counties with percentages equal to or greater than the state threshold were carried forward as containing low-income populations. A total of 10 counties are highlighted in column 4 of Table 4-4 as containing low-income populations.

It is important to note that communities with environmental justice concerns cannot always be fully captured by statistical data sources. Inclusion of these counties for analysis does not mean that communities with environmental justice concerns will necessarily be impacted by any given alternative evaluated in the RP/EA #2. Often, low-income or minority populations may be unevenly distributed across the analysis area. Further, there may be sensitive populations not captured statistically that could be uniquely susceptible due to 1) special vulnerabilities (e.g., preexisting health conditions that exceed norms among the general population); 2) unique routes of exposure (e.g., use of surface water or well water in rural communities); or 3) cultural practices (e.g., subsistence fishing, hunting or gathering, or access to sacred sites).

4.2.3.3 TOURISM AND RECREATIONAL USE

The Gulf Coast contains many natural areas that offer outdoor recreational opportunities, including wildlife management areas (WMAs) and national wildlife refuges. Along the Gulf Coast, there are 13 WMAs ranging in size from 37 acres to 43,900 acres. These WMAs offer outdoor recreation such as fishing, wildlife viewing, camping, hiking, hunting, biking (TPWD 2021d). The Texas Gulf Coast contains six national wildlife refuges (Anahuac National Wildlife Refuge, Aransas National Wildlife Refuge, Brazoria

National Wildlife Refuge, Laguna Atascosa National Wildlife Refuge, San Bernard National Wildlife Refuge, and Texas Point National Wildlife Refuge), six state parks (Copano Bay Causeway State Park, Galveston Island State Park, Goose Island State Park, Lake Corpus Christi State Park, San Jacinto State Park, and Texas State Park), and one national seashore (Padre Island National Seashore). These sites contain large acreages of protected habitat and offer visitors opportunities for wildlife viewing and birding. For instance, Padre Island National Seashore offers 66 miles of access to undeveloped barrier island and serves as a nesting ground for Kemp's ridley sea turtles and provides habitat for over 380 bird species. It also offers beaches, camping, boating, and fishing for visitors to enjoy (NPS 2021).

Per the 2018 Statewide Comprehensive Outdoor Recreation Plan, Brazoria, Jefferson, and Kenedy Counties contain the greatest amount of recreation conservation area within the analysis area evaluated in the RP/EA #2, ranging from 90,180 to 104,319 acres of recreation conservation lands that make up between 7% to 12% of total county acreages (TPWD 2017).

4.2.3.4 AESTHETICS AND VISUAL RESOURCES

Visual resources are the visible, physical features of a landscape that have an aesthetic value to viewers from viewpoints such as residences, recreational areas, rivers, and highways. Physical features that make up the visible landscape include land, water, vegetation, and human-made features (i.e., roadways, buildings, and structures), all of which contribute to the overall landscape and visual character of an area. A view refers to a direct and unobstructed line of sight to an on- or off-site aesthetic resource, which may take the form of panoramic viewpoints from particular vantages. Existing views may be obstructed or blocked by modifications to the environment (e.g., grading, landscaping, and building construction).

As noted in the *Coastal Texas Protection and Ecosystem Restoration Feasibility Study: Final Environmental Impact Statement* (Coastal Texas Feasibility Study) (USACE and TGLO 2021), which characterizes the marine navigation and transportation conditions along the Texas Gulf Coast, the Coastal Texas Feasibility Study states that "significant development occurs in and around the major cities and ports." The aesthetic view within these areas is characteristic of an urban environment with commercial and residential structures, including single and multi-story buildings, roadways, signs, and lighting. In and around the ports, industrial facilities and navigation traffic are common." Outside of developed areas, the Gulf Coast is generally characterized by views of riparian habitat, marshes, bays, beaches, islands, jetties, and open waters. Inland, the Western Gulf Coastal Plain is relatively flat and consists of mainly of views of grassland and natural vegetation and croplands (TPWD 2012).

4.2.3.5 INFRASTRUCTURE

Human-made infrastructure along the Texas Gulf Coast consists of both onshore and offshore components. Land-based infrastructure includes roads, bridges, underground pipelines, sewer systems, underground and overhead transmission lines and structures, oil and gas wells, wastewater facilities, and other public utilities. Marine infrastructure includes pipelines, oil and gas platforms and wells, subsea cables, marinas, piers, docks, mooring locations, water intakes, monitoring stations, and more.

4.2.3.6 FISHERIES

Top commercial fishing ports along the Texas coastline in 2020 are provided in Table 4-5. Total Texas coastwide landings in 2020 were 72.5 million pounds of seafood, valued at $195.4 million (NOAA 2020). Brown and white shrimp accounted for more than 50% of the weight and value of all seafood landed (Table 4-6) (NOAA 2020).

Table 4-5. Top Fishing Ports in Texas, 2020

Port	Pounds (in millions)	Value Dollars (in millions)
Brownsville-Port Isabel	17.2	46.4
Galveston	15.5	51.2
Port Arthur	14.1	29.1
Palacios	13.6	31.9

Table 4-6. Texas Commercial Fishery Landings by Species, 2020

Species	Pounds	Value Dollars
Shrimp, northern brown	35,327,842	81,595,472
Shrimp, northern white	21,615,321	52,954,857
Oyster, eastern	5,331,393	30,626,258
Snapper, red	2,754,861	12,176,300
Shrimp, *farfantepenaeus* spp.	1,334,371	5,849,174
Crab, blue	3,405,518	5,020,510
Shrimp, northern pink	844,449	2,386,676
Drum, black	1,070,032	1,471,488
Croaker, atlantic	114,583	1,273,279
Grouper, yellowedge	110,206	498,757
Mullets	101,005	394,021
Snapper, vermilion	92,402	276,239
Catfish, blue	109,271	105,863
Total, including others	**72,458,674**	**195,412,876**

4.2.3.7 MARINE TRANSPORTATION

Per the *Coastal Texas Feasibility Study* (USACE and TGLO 2021), marine transportation along the Gulf Coast is heavily dependent upon the GIWW, a 1,100-mile-long human-made canal that runs along the Gulf of Mexico coastline from Brownsville, Texas, to St. Marks, Florida. The GIWW facilitates both intrastate and foreign trade and serves as a marine highway connecting all ports along the Gulf Coast and major inland ports along the Mississippi River. The Texas portion of the GIWW, designated in 2016 as the Marine Highway 69 Corridor, is 379 miles long and connects commercial navigation channels, ports, and harbors within Texas; this segment alone handles up to 70% of the marine traffic along the entire GIWW (Texas Department of Transportation [TxDOT] 2021).

All 11 of Texas's deep-draft ports (25 feet or deeper) and eight shallow-draft ports, as well as private facilities, are interconnected via the GIWW and other intersecting tributaries and shipping channels (TxDOT 2021). Important large navigation channels in this region include the Sabine-Neches Waterway, Houston Ship Channel, Freeport Harbor Channel, Matagorda Ship Channel, Victoria Barge Canal, Corpus Christi Ship Channel, La Quinta Channel, and Brazos Island Harbor navigation channel. The width, depth, and navigability of shipping channels dictate the size and types of vessels they can accommodate, which has a direct impact on the types of goods and markets that can be served (Port Authority Advisory Committee 2020). Deep-draft channels convey large, ocean-going vessels while shallow-draft ports support barges and smaller vessels for local and regional cargo transport, commercial activities, and recreational boating. Texas ports and shipping channels are equipped to handle multiple cargo types, including, but not limited to, petroleum and petroleum products, natural gas, manufactured goods, machinery, containers, dry bulk, liquid bulk, military, chemicals, coal, aluminum ore, farm products, waste, and seafood (TxDOT 2014; USACE and TGLO 2021).

The USACE Galveston District, with support from nonfederal sponsors, is responsible for operating and maintaining federal shipping channels in Texas to their authorized dimensions by performing regular maintenance dredging and other channel improvement projects (USACE and TGLO 2021). The TxDOT Maritime Division promotes the development and intermodal connectivity of Texas ports, waterways, and marine infrastructure and operations, including the GIWW. Pursuant to the Texas Coastal Waterway Act, TxDOT serves as the official nonfederal sponsor for the GIWW and is responsible for acquiring rights-of-way and land for disposal of dredging material in support of operations and maintenance projects undertaken by the USACE.

Other resources and infrastructure that facilitate marine transportation include safety fairways, navigation aids (e.g., buoys, lighting, radar transponders, etc.), anchorage areas, public and private docks, and boat ramps.

4.2.3.8 LAND AND MARINE MANAGEMENT

Texas inland land use and development is generally managed at the municipality level through comprehensive planning, zoning, subdivision regulations, and permitting. In counties and cities with zoning ordinances such as the City of Galveston, vacant properties along the coast and barrier islands are zoned primarily for low- to medium-density single-family or multifamily residential use. Commercial areas are generally small and neighborhood scale, intended to support long-term residents, vacationers, and tourists. Industrial areas are common along shipping channels and near ports. With the exception of Cameron County, most counties along the Texas Gulf Coast generally do not have county-wide zoning ordinances or comprehensive plans outside of cities and towns. However, many of these counties have adopted subdivision ordinances or other coastal plans and policies to manage growth. Barrier islands such as Galveston, Follets, and the South Padre Island are experiencing substantial development pressure. While some private landowners and non-governmental organizations (e.g., Houston Audubon Society and The Nature Conservancy) have established conservation areas through fee-simple acquisition or easements in these areas, many vacant properties on barrier islands are currently owned by private real estate developers and may be slated for residential development.

Management of state-owned lands, shorelines, and submerged lands in Texas is primarily the responsibility of the TGLO, which leases state-owned land for many purposes, including oil and gas production, agriculture, commercial development, and habitat protection. The State of Texas owns all submerged lands within 10.35 miles of the coastline into the Gulf of Mexico (TGLO 2021). The TGLO issues leases for residential and commercial shoreline development, including leases for on- and offshore renewable energy projects. The TGLO has applied Resource Management Codes (RMCs) to its leasable state-owned tracts in Texas bays and estuaries and Gulf of Mexico waters to establish development guidelines and limit potentially harmful activities where sensitive resources or infrastructure are present. RMCs incorporate recommendations from other agencies with jurisdiction in those areas, including, but not limited to, the USACE, the USCG, NOAA, the NMFS, the USFWS, TPWD, and the THC. The TGLO's management activities are guided by policies and planning documents such as the following:

- Texas Coastal Resiliency Master Plan (TGLO 2019)
- Local beach access and dune protection plans, including erosion response plans
- Texas Coastal Management Program

4.2.3.9 PUBLIC HEALTH AND SAFETY

Potential hazardous, toxic, and radioactive waste (HTRW) concerns along the Texas coast includes hazardous materials, hazardous waste, and potential contamination by current or past industrial or other activities. The *Coastal Texas Feasibility Study* (USACE and TGLO 2021) discloses potential HTRW concerns along the Texas coastline. As a brief summary, the upper Texas coast from Orange and Jefferson Counties is heavily urbanized, while the middle Texas coast along Matagorda, Jackson, Victoria, and Calhoun Counties is less densely developed. However, HTRW concerns are associated with major industrial and commercial development within coastal cities and ports. The middle coast, from San Antonio Bay to Baffin Bay, contains the largest volume of regulated sites, while HTRW concerns for the lower coast (Kenedy, Willacy, and Cameron Counties) are most prominent in Port Isabel and the Port of Brownsville.

Noise, vessel, and onshore traffic conditions that can influence public health and safety are discussed in preceding sections. The Texas Coastal Resiliency Master Plan (TGLO 2019) identified the following additional existing coastal issues of concern that can impact public health and safety:

- Relative sea level rise, loss of shoreline vegetation, and increasing vessel traffic along the GIWW;
- Increases in land subsidence and coastal development, leading to increased community risk from nuisance flooding and extreme rainfall events; and
- Erosion, overwash, and breaching of barrier islands and Gulf beaches and dunes, leading to increased community risk due to high tides and storm surge.

At the time of the 2019 plan's publication, flooding in the coastal region due to higher sea levels, land subsidence, erosion, wetland loss, development in low-lying areas, higher than typical tide events, and storm surge from coastal storms was projected to be the natural hazard with the greatest economic threat in Texas, causing an expected $5.6 billion in property losses and accounting for 34% of all weather-related economic losses from 2018 to 2023. "Of the 18 coastal counties, only one has experienced fewer than 13 flooding events between 1960 and 2008, with the average number of major or minor floods per county ranging from 25 to 41 over that same time period" (TGLO 2019).

4.3 Environmental Consequences

This section is organized by restoration type under consideration in the RP/EA #2: Wetlands, Coastal, and Nearshore Habitats, Nutrient Reduction, Oysters, Sea Turtles, and Birds. An analysis of potential impacts to resources carried forward (see Table 4.1) for each alternative is included in Section 4.3.1 to 4.3.5. Additionally, activities associated with many of the alternatives under each of the restoration types are the same, and therefore would result in the same or very similar potential impacts. In those instances, the environmental effects analysis has grouped the alternatives together by resource.

This section also incorporates by reference analysis from the TX TIG RP/EA #1 (Texas TIG 2017), Final PDARP/PEIS (DWH Trustees 2016a), and RW RP/EA #1 (RW TIG 2021). The Texas TIG reviewed the PDARP/PEIS and RW TIG 2021 environmental consequences analyses and determined that the following findings remain relevant to the current NEPA analysis.

Wetlands, Coastal, and Nearshore Habitats: The Final PDARP/PEIS, incorporated by reference, states that wetlands, coastal, and nearshore habitat restoration actions could result in:

- short-term and long-term minor to moderate adverse impacts on the physical environment due to construction activities. Construction of hard structures such as breakwaters could involve use of heavy equipment on the shoreline and barges that cause short-term moderate adverse impacts from sediment disturbance and compaction, increased turbidity, and noise. Long-term minor adverse impacts could also occur from the placement of dredged material and breakwaters in shallow water areas. Restoration actions could benefit substrates by raising and stabilizing substrate elevations affected by subsidence and sea level rise and re-establishing natural hydrology needed to restore the function of coastal wetland communities. Land acquisition could also reduce disturbance of geology and substrates by protecting lands from development pressure. This could be a long-term beneficial effect.

- short-term minor to moderate adverse impacts to the biological environment during construction activities due to 1) disturbance to wetland vegetation during construction; and 2) displacement of land-based or aquatic faunal species resulting from staging equipment and materials, as well as entrapment of marine mammals. Long-term minor to moderate impacts could include conversion of vegetation (e.g., saline vegetation to more freshwater vegetation) with changes in the distribution of fauna communities. Restoration actions could provide long-term benefits for many ecologically and economically important animals, including fish, shrimp, shellfish, birds, sea turtles, marine mammals, and terrestrial mammals, by enhancing habitats that provide ecological benefits. Conservation of habitat through fee title acquisition could also limit development encroachment on coastal, riparian, or terrestrial habitats that are important for food supply and various life stages of some species.
- minor to moderate localized adverse impacts to socioeconomic resources if acquired lands otherwise could have been developed for residential housing or commercial uses. Short-term minor adverse impacts could also occur during construction through 1) limits on recreational activities; 2) temporary increases in traffic; and 3) adverse effects on aesthetics due to the presence of construction equipment, new breakwaters, or other changes to the surrounding environment. Habitat restoration actions could result in minor to moderate impacts on cultural and historic resources due to construction activities. However, land acquisition could protect these resources from future degradation or loss. Short-term benefits to the local economy could accrue through an increase in employment and associated spending during construction. Over the long term, these restoration actions could also provide long-term benefits through 1) increased opportunities for wildlife viewing, kayaking, canoeing, hunting, fishing, and other recreational activities; and 2) improved water quality, flood, and shoreline protection (DWH Trustees 2016a).

In addition to the PDARP/PEIS analysis, the TX TIG RP/EA #1 (Texas TIG 2017), which discloses potential impacts from the **Follets Island Habitat Acquisition** and **Matagorda Peninsula Habitat Acquisition** alternatives, is also incorporated here by reference. No adverse impacts to physical, biological, or socioeconomic resources were identified, with the exception of land management, which could have a minor, long-term adverse impact on local tax revenue if acquired lands otherwise could have been developed for residential housing or commercial uses. Long-term benefits could occur consistent with the Final PDARP/PEIS (DWH Trustees 2016a).

Nutrient Reduction: The Final PDARP/PEIS, incorporated by reference, states that nutrient reduction actions could result in:

- short-term minor adverse impacts on geology, substrate, hydrology, surface and ground water quality, air quality, and noise. However, long-term benefits could also occur because conservation practices could slow erosion, stabilize soils, improve water quality, and increase groundwater recharge.
- short-term minor adverse biological resource impacts during construction associated with nutrient application and management methods as well as soil erosion control practices. Long-term benefits to biological resources could result from 1) improved water quality in the watershed and associated estuary; and 2) reduced contaminant loadings (e.g., pesticides and fuel contaminants such as polyaromatic hydrocarbons and metals).

- short-term benefits to the local economy through an increase in employment and associated spending during construction activities. Improvements to water quality could result in indirect benefits to recreational activities and commercial fishing. If cultural or historic resources are present, minor adverse impacts could occur during construction activities (DWH Trustees 2016a).

Oysters: The Final PDARP/PEIS, incorporated by reference, states that oyster restoration actions could result in:

- short-term minor adverse impacts to physical resources (geology, substrates, water quality, air quality, and noise) as a result of cultch placement and other construction actions. Long-term benefits to substrates could occur from the placement of oyster shell or other suitable substrate for oyster recruitment. Placement of reefs could reduce wave energy reaching shorelines, which may reduce erosion of shorelines and stabilize substrates. Long-term benefits to water quality could also occur due to increased filter feeding by oysters.
- short-term minor adverse impacts to biological resources during placement of cultch or substrate due to increases in turbidity, reduced water clarity (and photosynthetically available light), increased crab predator abundance and subsequent predation on oyster spat, and burial of existing benthic communities. Long-term minor loss of habitat in construction footprints, as well as short-term minor to moderate adverse impacts to fish, turtles, and (albeit unlikely) marine mammals in the form of direct injury and/or mortality, including entrainment, could also occur. Creation of oyster habitat could support increased populations of oysters, which could be a long-term beneficial impact. Reef creation could also provide long-term foraging and nursery habitat and refuge for other organisms, including marine mammals, sea turtles, fish, and birds, as well as dissipate wave energy and improve water clarity, in turn, benefiting submerged aquatic vegetation and marshes.
- short-term, minor to moderate adverse impacts to human use within the areas designated as oyster reserves by removing those areas from potential harvest, as well as long-term adverse impacts to cultural and historic resources that may be located in the restoration area. Restoration actions could provide short-term benefits to the local economy through an increase in employment and associated spending during construction activities. Increased recreational and commercial shellfish harvest opportunities, improved shoreline integrity, and reduced risk of potential hazards, such as storm surges, could also represent long-term benefits (DWH Trustees 2016a).

Sea Turtles: The Final PDARP/PEIS, incorporated by reference, states that sea turtle restoration actions could result in:

- localized long-term minor adverse impacts to physical resources associated with 1) disturbance and suspension of sediments and noise from increased enforcement vessel traffic; and 2) sand compaction and erosion on beaches from human activities and use of equipment during mobilization of stranding and response efforts. Short-term minor adverse impacts could also occur during habitat protection actions; however, these actions could not attract attention, dominate the soundscape, or detract from current user activities or experiences.
- long-term minor adverse impacts to fish and wildlife due to increased vessels and/or vehicle interactions. Restoration activities requiring human activity and vehicle traffic on nesting beaches could result in short- to long-term adverse effects. Sea turtle restoration actions could provide a long-term benefit to sea turtles by 1) increasing nesting success and hatchling survivorship; 2) increasing in the success of rescue, rehabilitation, and release of live sea turtles; and 3) reducing sea turtle bycatch and mortality via increased fisheries compliance. These actions could also benefit other species that depend on beach or dune habitat and adjacent shallow water habitats or are at risk from stranding.

- short-term benefits to regional economies during construction activities. Long-term minor adverse effects could occur due to increased human and vehicular traffic responding to strandings, which could negatively affect boater or beachgoer experiences. However, these actions could also provide long-term beneficial impacts to recreational experiences and wildlife viewing. Instances of noncompliance are expected to decrease over time if steady, consistent enforcement efforts are applied, which could result in potential law enforcement job opportunities and reduced conflict among legal and illegal fishers. An expanded STSSN could also increase the ability for personnel to respond to sea turtle stranding events and/or emergencies on water or land (DWH Trustees 2016a).

In addition to the PDARP/PEIS analysis, the RW RP/EA #1 (RW TIG 2021), which discloses potential impacts associated with the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative and would provide partial funding for this alternative (Section 3.6.1), is also incorporated here by reference. The RW RP/EA #1 described potential impacts to geology and substrates, hydrology, and water quality as localized short- to long-term minor adverse impacts due to sediment disturbance and increased turbidity. Impacts to habitats, wildlife, marine and estuarine resources, and protected species were described as short- to long-term minor adverse impacts due to habitat alteration, wildlife disturbance/displacement, and collision risk. Impacts to socioeconomic resources include short-term, minor adverse impacts to recreational use during implementation, and benefits to tourism and recreational use from the addition of visitor and educational activities.

Birds: The Final PDARP/PEIS, incorporated by reference, states that bird restoration actions could result in:

- short-term adverse impacts to soils, geology, water quality, and air quality during construction activities. Minor adverse impacts are anticipated for activities associated with stewardship and enhancing nest sites. Protecting bird habitat could have long-term benefits to geology, substrates, and water quality by preventing disturbance and loss of soil and reducing erosion.
- minor to moderate adverse impacts to biological resources. Placement of shells and/or borrow materials on estuarine sediments could have moderate to major adverse impacts by burying and replacing existing habitats. Long-term benefits could include conservation of bird nesting and foraging habitats, which would increase bird health and reproduction.
- minor short- to long-term adverse impacts to socioeconomic resources. However, improvements in habitat associated could draw additional visitors to the area with associated visitor spending, increasing sales and tax receipts on retail purchases. Bird restoration actions could result in minor to moderate adverse impacts on cultural and historic resources due to construction activities. However, land acquisition would allow for future protection of these resources, if present (DWH Trustees 2016a).

In addition to the PDARP/PEIS analysis, the RW RP/EA #1 (RW TIG 2021), which discloses potential impacts associated with the **San Antonio Bay Bird Island** alternative and would provide partial funding for this alternative (Section 3.7.3), is also incorporated here by reference. Impacts to geology and substrates and hydrology and water quality were described as localized short- to long-term minor adverse impacts due to placement of fill material and increased turbidity. Long-term benefits would accrue from reduced erosion and soil loss, as well as improved water quality. Impacts to habitats, wildlife species, marine and estuarine resources, and protected species were described as short- to long-term, minor adverse impacts due to disruption, increased turbidity, placement of fill/rock, and local habitat loss. The alternative would also increase habitat complexity in the long term, which would benefit benthic species and provide prey/feeding areas for other marine species. Impacts to socioeconomic resources included short-term, minor adverse impacts to public health and safety from the operation of heavy equipment;

however, these impacts would be mitigated through adherence to BMPs and use of personal protective equipment. Following project implementation, there would be benefits to tourism and recreation as the project would increase the abundance of colonial waterbirds in the region, thus enhancing wildlife viewing. There would also be benefits to fisheries from the addition of submerged hard surfaces and gaps that will provide places for aquatic organisms to live.

Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) contains BMPs to avoid or minimize impacts to protected and listed species, their habitats, and aquatic areas and are incorporated into the RP/EA #2's environmental consequences analysis for protected species. Additional BMPs that may be implemented as part of an alternative to reduce potential impacts generally include guidance developed during the permitting process, environmental reviews, consultation process, and other relevant regulatory requirements. The Texas TIG would also consider BMPs (as appropriate and referenced in Appendix B of this document), design criteria, lessons learned, and expert advice. These BMPs are incorporated into the environmental consequences analysis as applicable.

4.3.1 Wetlands, Coastal, and Nearshore Habitats

Three of the alternatives under this restoration type involve fee simple habitat acquisition: the **Follets Island Habitat Acquisition Phase 2**, **Galveston Island Habitat Acquisition**, and **Matagorda Peninsula Habitat Acquisition** alternatives (hereafter referred to collectively as the **Habitat Acquisition** alternatives). Two of the Habitat Acquisition alternatives would add lands to existing TPWD CMAs. The **Follets Island Habitat Acquisition Phase 2** alternative would add up to 350 acres of wetland and coastal habitats on Follets Island between San Luis Pass and Drum Bay, Texas, to the Follets Island CMA. The **Matagorda Peninsula Habitat Acquisition** alternative would acquire up to 400 acres of wetland, coastal, and nearshore habitats on Matagorda Peninsula east of the Colorado River in Matagorda County, Texas, to be added to the Matagorda Peninsula CMA. The **Galveston Island Habitat Acquisition** alternative would acquire approximately 142 acres of connected barrier island coastal and wetland habitats on West Galveston Island that would be part of a greater conservation area.

Two of the alternatives under this restoration type would include construction activities. The **Bird Island Cove Habitat Restoration - Construction** alternative would construct approximately 8,820 LF of breakwaters in West Galveston Bay to protect up to 85 acres of natural estuarine marsh complex and create up to 17,640 LF of three-dimensional hard-structure habitat for fisheries species. The **Bahia Grande Channel F Hydrologic Restoration** alternative would restore the flow of freshwater from north of Highway 100 to Laguna Larga and restore natural hydrology to approximately 800 acres of the Bahia Grande System by modification of ditches, installation of box culverts under Highway 100, and the construction of a conveyance channel (Channel F) to route water flow into Laguna Larga.

Maps of each wetlands, coastal, and nearshore habitat alternative are provided in Sections 3.3.1 to 3.3.5.

4.3.1.1 PHYSICAL RESOURCES

4.3.1.1.1 Geology and Substrates

The **Bird Island Cove Habitat Restoration - Construction** alternative would construct approximately 8,820 LF of breakwaters in West Galveston Bay. These breakwater construction activities would cause localized short- to long-term, minor to moderate adverse impacts from sediment disturbance or changes to sediment dynamics (e.g., the movement of sediment during transport and settlement). Dredging of approximately 13,500 LF of floatation channel would also result in short-term minor adverse impacts to the substrate in the channel footprint. However, the dredged material could be used as fill for up to 15 marsh mounds (within a 12-acre area) if deemed suitable for reuse. BMPs described in Section 6,

Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of the RP/EA #2 would be implemented to avoid or minimize impacts to geology and substrates. In the long term, geology and substrates would benefit from the alternative as placement of breakwaters would result in shoreline stabilization, helping to reduce ongoing erosion of the island.

The **Bahia Grande Channel F Hydrologic Restoration** alternative would remove sediment within the channel at the mouth of Ostermayer Bayou to increase the tidal connection. Excavation would result in long-term minor substrate alteration, as the existing ditch would be filled in with approximately 551.6 cubic yards of material, and the construction of the new conveyance channel would require removal of approximately 35,956 cubic yards of material. Concrete box culvert(s) would be installed to convey water beneath Highway 100, with stone riprap placed at the outfall location to minimize erosion. During construction, use of heavy equipment such as excavators and graders could also lead to localized short-term minor to moderate adverse impacts from sediment disturbance and compaction in areas used for staging. However, staging areas would be regraded and revegetated as appropriate, once construction is complete. Removed sediment would also be disposed of in compliance with all relevant regulations. BMPs, as appropriate and described in Appendix B of this document, would be implemented to further avoid or minimize impacts to geology and substrates. Long term, restoring this tidal connection would benefit geology and substrates by encouraging colonization of various plant species and “patching” eroded gullies or other damage to existing lomas (clay dune formations), which would promote substrate stabilization and reduce erosion risk.

4.3.1.1.2 Hydrology and Water Quality

In-water disturbance associated with the **Bird Island Cove Habitat Restoration - Construction** and **Bahia Grande Channel F Hydrologic Restoration** alternatives would have short-term localized minor adverse impacts to water quality in waters from increases in turbidity. Additionally, vessels and equipment used for construction could leak or discharge oil, fuels, or other fluids. These impacts would be localized and short term, as leaks or discharges would be anticipated to occur rarely, be responded to as required by law, and would dissipate quickly. These alternatives would be implemented in accordance with BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document, to minimize impacts on hydrology and water quality during construction.

Decreased erosion and sedimentation from shoreline protection under the **Bird Island Cove Habitat Restoration - Construction** alternative could result in long-term benefits to water quality. Reconnecting the coastal marsh to tidal floodplain and restoring the natural hydrology would also result in a long-term beneficial effect for the **Bahia Grande Channel F Hydrologic Restoration** alternative.

4.3.1.1.3 Air Quality

The **Bird Island Cove Habitat Restoration - Construction** alternative is located in the Houston-Galveston-Brazoria 8-hour ozone nonattainment area, while the **Bahia Grande Channel F Hydrologic Restoration** alternative is located in an attainment area. Engine exhaust from construction equipment and vehicles associated with both alternatives would contribute to an increase in criteria air pollutants, GHGs, and other air pollutants. These emissions would be measurable but localized and temporary, quickly becoming undetectable, and would not exceed CAA *de minimis* criteria for general conformity (40 CFR Section 93.153). With implementation of the BMPs, as appropriate and described in Appendix B of this document, adverse impacts to air quality during construction would be short term and minor.

4.3.1.1.4 Noise

Construction activities for the **Bird Island Cove Habitat Restoration - Construction** and **Bahia Grande Channel F Hydrologic Restoration** alternatives would include transporting materials, riprap, dredged material, and other construction-related items, as well as the use of heavy equipment such as excavators and graders that would generate noise. These noise sources would be noticeable but restricted to daylight hours and would decrease rapidly over distance from the noise source. Therefore, adverse impacts would be short term and minor and end once construction was completed.

4.3.1.2 BIOLOGICAL RESOURCES

4.3.1.2.1 Habitats

No adverse impacts are anticipated for the **Follets Island Habitat Acquisition Phase 2**, **Galveston Island Habitat Acquisition**, and **Matagorda Peninsula Habitat Acquisition** alternatives (hereafter referred to collectively as the **Habitat Acquisition** alternatives), as land acquisition would not result in ground-disturbing activities. However, **Habitat Acquisition** alternatives would result in long-term benefits to habitats by preventing disturbances that could remove or alter coastal and upland habitats.

Construction of the breakwaters for the **Bird Island Cove Habitat Restoration - Construction** alternative would permanently convert open water and soft-sediment habitats to hard-bottom habitat within the footprint of the 8,820 LF of breakwaters. Because ample open water habitat is available in the surrounding area, this would be a long-term minor adverse impact. Construction activities would also increase the risk of spills and expose habitats in the vicinity to short-term minor increases in turbidity.

New breakwaters would promote a more complex and natural estuarine ecosystem that provides foraging, resting, and nursery habitat for a variety of species. Creation of upland habitats in this complex could also be used by birds and other terrestrial species. This would represent a long-term benefit to habitats.

The **Bahia Grande Channel F Hydrologic Restoration** alternative would result in short-term minor adverse impacts to wetlands and shallow open water habitats present within areas of ditch modification, box culvert installation, and conveyance channel construction. However, this alternative would be implemented in accordance with BMPs as described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document, to minimize impacts to habitats during construction. In the long term, restoring natural hydrologic functions would improve habitat quality in the area.

4.3.1.2.2 Wildlife

The **Habitat Acquisition** alternatives would result in long-term benefits to wildlife by preserving lands that would otherwise be developed, maintaining the ecological value they provide for wetlands, coastal, and nearshore species, including migratory and shorebirds, small mammals, and reptiles.

Construction of the **Bird Island Cove Habitat Restoration - Construction** alternative would occur primarily in the marine environment. However, terrestrial species, particularly birds that use the open water for foraging areas, could be disturbed or displaced by noise or human activity during breakwater construction. This would be a short-term minor adverse impact, as ample coastal and open water marine habitat is available in the vicinity. Land grading and construction activities associated with the **Bahia Grande Channel F Hydrologic Restoration** alternative also could result in displacement, injury, or mortality of individual small reptiles, mammals, or other terrestrial species. However, these impacts would be considered minor because while detectable, the effect would be localized and would not result in population-level impacts. Birds and other mobile animals would likely be capable of relocating to other suitable areas for nesting, resting, and foraging. Both alternatives would be implemented in accordance with BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B in this document, to minimize impacts to wildlife and birds during construction. Restoration actions would improve the quality of available habitat for shorebirds, rookeries, and other wildlife, resulting in a long-term benefit.

4.3.1.2.3 Marine and Estuarine Resources

The **Habitat Acquisition** alternatives would result in long-term benefits to marine and estuarine species by preventing development in coastal areas that have connectivity to these areas. Preserving these coastal habitats as undeveloped land would reduce stormwater runoff, erosion, and sedimentation, all of which could adversely affect habitats used by marine and estuarine species.

Construction activities for the **Bird Island Cove Habitat Restoration - Construction** alternative would require use of transportation barges for dredging the floatation channel and for placement of dredged material on the seafloor as well as use of other equipment that could disturb marine and estuarine habitat. These activities would result in minor to moderate short-term adverse impacts to marine and estuarine species due to increased turbidity, siltation, entrainment of benthic species, temperature changes, increased biological oxygen demand due to the introduction of organic matter into the water column, decreased dissolved oxygen, vibration, and noise. Breakwater installation could smother benthic resources and would convert soft-bottom habitats to hard-bottom habitats, adversely impacting species long term that depend on this habitat. The use of heavy equipment and vessel traffic could also lead to injury or mortality of individuals and could adversely affect EFH. However, more mobile species would likely be capable of avoiding construction activities, resulting in short-term minor displacement. No population-level impacts are anticipated.

Increases in in-water turbidity during breakwater construction could disturb feeding or spawning and other behaviors by some estuarine and marine fauna and prey individuals. However, ample similar marine and estuarine habitat is available in the vicinity if individuals are displaced into surrounding areas, and turbidity levels would return to preconstruction conditions once construction ends; therefore, these would be short-term minor adverse impacts. BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document, would be implemented to reduce potential effects from construction-related activities. If submerged aquatic vegetation is found, measures would also be taken to avoid or minimize impacts.

In the long term, proposed breakwaters associated with the **Bird Island Cove Habitat Restoration - Construction** alternative would attract new species of attached organisms, and beneficial changes to the benthic community could occur, such as increased populations of oysters and algae and the species that feed on them (Bulleri and Chapman 2010). This structure would improve habitat for spawning, nursing, foraging, and shelter. Marsh protection would also benefit species within the ecosystem by continuing to contribute to the aquatic food web and maintaining a productive habitat. The **Bahia Grande Channel F Hydrologic Restoration** alternative would also restore hydrologic connectivity, which indirectly would improve estuarine areas used by species for feeding, spawning, and nursery habitats.

4.3.1.2.4 Protected Species

The **Bahia Grande Channel F Hydrologic Restoration** alternative could cause short-term minor adverse impacts to protected shorebirds, including piping plover and red knot, which are known to occur within wetlands, channels, and mudflats, as well as to the eastern black rail, which occurs in coastal tidal marshes, and the northern aplomado falcon, which occurs in open grassland and savannah habitats. Increased human presence, noise, and turbidity within wetlands could temporarily displace these bird species during construction. Additionally, upland grading in scrub and riparian habitat adjacent to the channel could disturb or displace the federally endangered ocelot (*Leopardus pardalis*), which is known to occur in Texas only within the Laguna Atascosa National Wildlife Refuge. However, this species is incredibly rare and occurs primarily in very dense shrublands. Therefore, the probability of encountering an ocelot during construction is extremely low. Both ocelots and protected bird species are highly mobile and are likely to avoid collisions with construction equipment and vehicles. Furthermore, implementation of BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs as appropriate and described in Appendix B of this document would minimize impacts to ocelots and protected bird species during construction activities.

The **Bird Island Cove Habitat Restoration - Construction** alternative could result in short-term minor adverse impacts to protected sea turtle species, including green sea turtle, hawksbill sea turtle, Kemp's Ridley sea turtle, and loggerhead sea turtle, as well as protected marine mammals, including West Indian manatee, and protected bird species including piping plover, whooping crane and red knot, if an individual were to pass through the area during construction activities. Dredging and riprap placement would increase turbidity and noise disturbance, leading to short-term disturbance or displacement of individuals. Sea turtles, marine mammals, and fish are highly mobile marine species, and it is likely that any individuals in the vicinity of restoration activities would leave and avoid injury from construction activities. This alternative would be implemented in accordance with BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a), and BMPs as appropriate and described in Appendix B of this document would be implemented to minimize collateral injury, including NMFS's *Measures for Reducing Entrapment Risk to Protected Species* (NMFS 2012), *Vessel Strike Avoidance Measures* (NMFS 2021a), *Protected Species Construction Conditions* (NMFS 2021b), and USACE *Standard Manatee Conditions for In-Water Work* (USACE 2011). The restoration or creation of new habitat would result in long-term benefits to protected species by enhancing resources that are an important part of the food chain for coastal and marine wildlife.

Two of the **Habitat Acquisition** alternatives**—Follets Island Habitat Acquisition Phase 2** and **Matagorda Peninsula Habitat Acquisition—**would allow recreation activities, which could result in minor short-term disturbance or displacement of protected birds such as piping plover, eastern black rail, northern aplomado falcon, and red knot, as well as protected sea turtle species, including green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, and loggerhead sea turtle.

All of the **Habitat Acquisition** alternatives would support a diversity of wildlife within marsh, mudflat, beach, dune, and other suitable habitats that provide foraging, roosting, and nesting habitats for multiple federally protected species. Therefore, land acquisition would result in long-term benefits to protected species, as these alternatives would eliminate the threat of future degradation of the ecological values of these properties.

4.3.1.3 SOCIOECONOMIC RESOURCES

4.3.1.3.1 Cultural Resources

An SOI-qualified archaeologist preliminarily reviewed the TASA for previously recorded cultural resources surveys and previously identified resources in the vicinity of the **Bird Island Cove Habitat Restoration - Construction** and the **Bahia Grande Channel F Hydrologic Restoration** alternatives. A cultural resources survey of the **Bird Island Cove Habitat Restoration - Construction** alternative was conducted by BOB Hydrographics, Inc. in 2020 (Gearhart 2020). No potentially significant submerged archaeological resources were identified. The **Bahia Grande Channel F Hydrologic Restoration** alternative has not been previously surveyed for cultural resources, and no previously recorded cultural resources are mapped. Regardless of existing cultural resource surveys, formal review by DWH cultural resource liaisons would still be required for all preferred Wetlands, Coastal and Nearshore Habitat projects to determine whether cultural resources are present and could be impacted by the alternatives.

The Implementing Trustee would be responsible for ensuring that compliance with Section 106 of the NHPA in accordance with 36 CFR Section 800 and 33 CFR Section 325, Appendix C is complete prior to ground-disturbing activities. Impacts to cultural resources for this alternative would depend on the cultural resources present, their exact nature (the conditions that make the resources eligible for the NRHP, if present), expected impacts, and the regulatory environment. Construction, ground disturbance, or other activities that could potentially alter the historic integrity of any culturally or historically important resources identified during project preparations or predevelopment surveys would be avoided during project implementation. A complete review of all alternatives to satisfy the requirements of Section 106 of the NHPA is ongoing and 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 project area. Alternatives would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

4.3.1.3.2 Socioeconomics and Environmental Justice

Property acquisition for all **Habitat Acquisition alternatives** would permanently limit the amount and type of development that would be permitted on acquired lands, and the management and the intensity of use on these properties would likely change. However, transactions would be negotiated or arranged between willing parties and, as such, are not expected to cause adverse socioeconomic impacts to those who choose to engage in such transactions. As described in the Final PDARP/PEIS (DWH Trustees 2016a), these alternatives could result in localized minor to moderate long-term adverse effects due to changes in development activities, spending, and taxes if acquired parcels would have otherwise been developed for residential housing or commercial uses.

During construction, access to areas in the vicinity of the **Bahia Grande Channel F Hydrologic Restoration** and **Bird Island Cove Habitat Restoration - Construction** alternatives could be restricted, which could cause minor short-term adverse impacts to some individuals. Short-term beneficial effects to the local and regional economies could also occur from construction-related employment for these alternatives. These jobs would likely provide some income, sales, and economic activity in the immediate area. Long term, most wetlands, coastal, and nearshore habitat alternatives could enhance economic opportunities associated with wildlife viewing, kayaking, canoeing, hunting, fishing, and other recreational activities, which could result in economic benefits from increased visitor spending. The **Bahia Grande Channel F Hydrologic Restoration** would not provide public access so there would be no change in long-term recreation-related economic opportunity.

Wetlands, coastal, and nearshore habitat alternatives would occur in or near two counties with low-income and/or minority populations: Cameron and Matagorda Counties. Analysis of these communities with environmental justice concerns occurred in the following multistep process:

- Analysis of wetlands, coastal, and nearshore habitat alternatives' impacts to physical, biological, and socioeconomic resources was conducted to identify adverse and beneficial impacts for the general population.
- Identified impacts were evaluated to determine whether the distribution of impacts would significantly differ between the general population and communities with environmental justice concerns (referred to as the Impact Focused Approach in the EPA's 2016 guidance document). This analysis specifically considered whether:
    - exposure by communities with environmental justice concerns to an environmental hazard appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population; and

  - human health or environmental impacts would be 1) predominantly borne by communities with environmental justice concerns, 2) above generally accepted norms, 3) likely to appreciably exceed the risk or rate to the general population, 4) occurring in populations affected by cumulative or multiple adverse exposures from environmental hazards, and 5) identified as significant and adverse.
- BMPs or other relevant mitigation measures were evaluated for effectiveness in avoiding or reducing adverse impacts identified in the above steps.
- Impacts were evaluated to determine whether they would cause disproportionately high and adverse impacts to communities with environmental justice concerns. This determination was based on whether adverse impact(s) to communities with environmental justice concerns would still remain after accounting for BMPs and other mitigation measures.

Due to the limited duration and magnitude of impacts, the Texas TIG does not believe that adverse impacts associated with the wetlands, coastal, and nearshore habitat alternatives would be disproportionately born by communities with environmental justice concerns or exceed risk levels relative to the general population. Implementation of BMPs would further reduce the magnitude of these impacts. The Implementing Trustee will conduct outreach that includes strategies to reach low-income and minority populations. Additionally, the Texas TIG will engage with local officials and residents throughout the public involvement process for the RP/EA #2.

4.3.1.3.3 Tourism and Recreational Use

Construction of the **Bird Island Cove Habitat Restoration - Construction** alternative would result in minor short-term adverse impacts to tourism and recreation use in the vicinity of each alternative due to construction noise, equipment, and activities, which could restrict access or cause recreationists to avoid work areas during construction. Construction activities for both alternatives would also result in temporary changes to the aesthetics, which would have minor and short-term adverse effects on tourism and recreation use.

Two of the **Habitat Acquisition** alternatives—**Follets Island Habitat Acquisition Phase 2** and **Matagorda Peninsula Habitat Acquisition**—would allow recreation activities such as going to the beach, fishing from the shore, and wildlife viewing within the current CMAs. The **Galveston Island Habitat Acquisition** alternative is not anticipated to change tourism and recreation use, as parcels are currently privately owned and would be managed to retain controlled public access once acquired.

4.3.1.3.4 Aesthetics and Visual Resources

Construction activities from the **Bahia Grande Channel F Hydrologic Restoration** and **Bird Island Cove Habitat Restoration - Construction** alternatives could result in short-term adverse impacts to aesthetics and visual resources due to views of construction activities and equipment. Island, marsh, and habitat restoration would result in long-term beneficial impacts, however, by generating higher quality aesthetics and more favorable natural landscapes. Long-term benefits from the **Habitat Acquisition** alternatives would also occur from the preservation of natural habitat and the prevention of future degradation or loss that could adversely impact aesthetics and visual resources.

4.3.1.3.5 Infrastructure

No adverse impacts are anticipated for the **Habitat Acquisition** alternatives, as land acquisition would not alter demand for, or impacts to existing infrastructure. However, **Habitat Acquisition** alternatives could provide long-term benefits to existing infrastructure since preservation of undeveloped coastal areas would protect roads, bridges, and other infrastructure from storm surge and erosive wave damage.

The **Bahia Grande Channel F Hydrologic Restoration** and **Bird Island Cove Habitat Restoration - Construction** alternatives would involve construction activities that could result in short-term minor interruption or damage to existing infrastructure within construction footprints. However, alternatives would be sited to avoid destroying, damaging, burying, or exposing existing subsea pipelines, cables, and other infrastructure to the extent possible in accordance with state law, the applicable RMCs, and BMPs in Appendix B of this document.

Placement of the breakwater proposed under the **Bird Island Cove Habitat Restoration - Construction** alternative would provide a long-term benefit by reducing existing erosive conditions on the island and providing long-term protection to infrastructure on the landward side of the breakwater by preventing coastal erosion, improving shoreline integrity, and providing a buffer against potential hazards (i.e., storm surge, sea level rise, flooding). The **Bahia Grande Channel F Hydrologic Restoration** alternative would also protect estuarine marsh systems that could protect infrastructure from sea level rise and erosion and improve coastal resiliency, resulting in a long-term beneficial impact.

4.3.1.3.6 Fisheries and Aquaculture

The **Habitat Acquisition** alternatives do not coincide with fisheries and aquaculture activities. Therefore, no direct impacts to fisheries or aquaculture would occur. However, acquisition or restoration of lands that contain coastal marshes, an important nursery habitat for commercial and recreational important species, would provide a long-term benefit.

The **Bahia Grande Channel F Hydrologic Restoration** and **Bird Island Cove Habitat Restoration - Construction** alternatives could result in short-term effects to commercial fishing due to in-water activities that could temporarily displace nearby fish species. Additionally, for the **Bird Island Cove Habitat Restoration - Construction** alternative, some fishing grounds could temporarily be off-limits during construction. These would be short-term minor adverse impacts. In the long term, placement of the breakwaters would provide a hard surface for encrusting species (oyster and others mentioned above) and filamentous algae to attach. These habitat features would attract other invertebrates (e.g., amphipods, isopods, and copepods), which attract other fishery species (e.g., planktivorous, carnivorous, and scavengers). Additionally, creation of the **Bird Island Cove Habitat Restoration - Construction** alternative could increase available shallow water estuarine areas that provide habitat for juveniles and feeding for some species of fish and shellfish. These would represent long-term benefits for the alternative.

4.3.1.3.7 Marine Transportation

During construction of the **Bird Island Cove Habitat Restoration - Construction** alternative, the presence of construction vessels and platforms would result in a minor short-term adverse impact to navigation in the area. However, staging and anchoring areas would be sufficiently offset from any navigation channels, so that there would be sufficient space for recreational and larger commercial vessels to avoid construction equipment and vessels. Multiple construction activities occurring in the same area would be completed in phases or coordinated, to the extent practicable to minimize vessel-related accidents and conflicts.

Once installed, the breakwaters could also result in changes to marine navigation safety and routes. However, standard USCG requirements would be implemented, such as notices to mariners, temporary lights on equipment and material barges, and/or use of signage or navigational aids on submerged structures and reefs. Required signage would not be located within any local navigation channel, either maintained or natural. New breakwaters would be added to navigation charts to avoid possible navigation impacts. Additionally, breakwaters would be sited to avoid existing navigation channels. Therefore, adverse impacts would be long term but minor.

4.3.1.3.8 Land and Marine Management

Conserving habitat by acquiring property through fee acquisition for all **Habitat Acquisition** alternatives would permanently limit the amount and type of development that would be permitted on these lands, and the management and the intensity of use on these properties would likely change. However, transactions would be negotiated or arranged between willing parties and, as such, are not expected to cause adverse impacts to those who choose to engage in such transactions. Human activity would be managed to prevent impacts to the land, and existing trails, roads, or access points deemed compatible with the land management objectives for these properties would be maintained for use. The **Habitat Acquisition** alternatives would provide a long-term benefit by precluding development on lands that could be at risk from future severe storms and sea level rise.

4.3.1.3.9 Public Health and Safety

During construction of the **Bird Island Cove Habitat Restoration - Construction** and **Bahia Grande Channel F Hydrologic Restoration** alternatives, the operation of heavy equipment, vehicles, and/or offshore vessels could result in short-term minor adverse risks to public health and safety. Navigation impacts are discussed in Section 4.3.1.3.7. If hazardous chemicals or other materials are unintentionally released into the environment, soils, groundwater, and surface waters would be adversely impacted. However, any hazardous materials used during construction would be contained, and BMPs, as appropriate and described in Appendix B of this document would be implemented to protect health and safety. In the long term, implementation of these two alternatives would reduce coastal shoreline erosion and improve hydrology, thereby also reducing health and safety concerns.

The **Habitat Acquisition** alternatives would preserve lands in their current undeveloped state. This action would prevent development that could be affected by tropical storm winds and tides. Additionally, the preservation of habitat would allow the landscape to recover more quickly after storms, would provide public safety protection in the area from storm surges and wave action, and would provide coastal resiliency. These outcomes represent a long-term benefit to public health and safety.

4.3.1.4 SUMMARY

As described in detail above, the **Follets Island Habitat Acquisition Phase 2** alternative would result in the following impacts:

- Physical resources – There would be no adverse or beneficial impacts to physical resources since this alternative would not result in ground-disturbing activities that could impact geology and substrates, water quality, air quality, or noise.
- Biological resources – This alternative would allow recreation activities, which could result in minor short-term disturbance or displacement of protected bird or sea turtle species. Long-term benefits to habitats, wildlife, marine and estuarine resources, and protected species include preventing disturbances that could remove or alter coastal and upland habitats, or that have connectivity to estuarine areas, and maintaining the ecological value these lands provide for a variety of species, including migratory and shorebirds, small mammals and reptiles.
- Socioeconomic resources – Impacts would be localized minor to moderate long-term adverse effects due to changes in development activities, spending, and taxes if acquired parcels would have otherwise been developed for residential housing or commercial uses. No disproportionately high and adverse impacts to communities with environmental justice concerns are anticipated. This alternative would provide a long-term benefit by 1) allowing recreation activities within the current CMAs; 2) preventing future degradation or loss that could adversely impact aesthetics and

visual resources; 3) preserving undeveloped coastal areas that would protect infrastructure and public health and safety from storm surge and erosive wave damage; and 4) protecting nursery habitat for commercial and recreational important species.

All other **Habitat Acquisition** alternatives would result in similar adverse and beneficial impacts as the **Follets Island Habitat Acquisition Phase 2** alternative. However, the **Galveston Island Habitat Acquisition** alternative is not anticipated to change tourism and recreation use, as parcels are currently privately owned and would be managed to retain controlled public access once acquired.

As described in detail above, the **Bird Island Cove Habitat Restoration - Construction** alternative would result in the following impacts:

- Physical resources – Impacts would be short- to long-term and minor to moderate adverse impacts from sediment disturbance, turbidity, air emissions, and noise due to dredging, excavation, equipment operation, and other construction actions. Placement of breakwaters would result in long-term beneficial substrate stabilization, reduced erosion risk, and improved water quality.
- Biological resources – There would be short- to long-term and minor to moderate adverse impacts from habitat conversion, wildlife disturbance, or displacement, as well as increased turbidity, siltation, entrainment of benthic species, temperature changes, and increased biological oxygen demand. New breakwaters would promote a more complex and natural estuarine ecosystem that provides long-term foraging, resting, and nursery habitat benefits for a variety of species.
- Socioeconomic resources – There would be minor short-term adverse impacts to tourism and recreation use, public health and safety, and aesthetics due to construction noise, equipment, and activities. Construction activities could result in short-term minor interruption or damage to existing infrastructure and navigation or result in short-term effects to commercial fishing due to in-water activities that could temporarily displace nearby fish species. No disproportionately high and adverse impacts to communities with environmental justice concerns are anticipated. This alternative would provide a short- to long-term benefit by 1) generating construction-related and recreation-based employment and spending; 2) preventing coastal erosion, improving shoreline integrity, and providing a buffer against potential hazards (i.e., storm surge, sea level rise, flooding); and 3) providing habitat for some species of commercially or recreationally important fish and shellfish.

The **Bahia Grande Channel F Hydrologic Restoration** alternative would result in similar types of adverse impacts to those discussed for the **Bird Island Cove Habitat Restoration - Construction** alternative because both alternatives propose construction activities to restore habitat. However, the **Bahia Grande Channel F Hydrologic Restoration** alternative would provide long-term benefits by reconnecting the coastal marsh to tidal floodplain and restoring the natural hydrology.

4.3.2 Nutrient Reduction

Two of the proposed Nutrient Reduction alternatives—the **Petronila Creek Watershed Nutrient Reduction Initiative** and the **Crooked Ditch Restoration** alternatives—propose to reduce nutrient loads from crop and grazing lands. The **Crooked Ditch Restoration** alternative would construct vegetated buffers along a 7.6-mile-long channelized waterway in Nueces County, while the **Petronila Creek Watershed Nutrient Reduction Initiative** alternative would consist of outreach and financial and technical assistance to voluntary participants to develop and implement conservation practices (CPs) on agricultural land that is vulnerable to nutrient and sediment runoff. The USDA has a long-standing structured, interdisciplinary, science-based, and public process for developing CP standards and analyzing the effects of those practices. Implementing these CPs has been proven to successfully address natural resource concerns related to agricultural lands. CPs are found in NRCS's National Handbook of Conservation Practices (USDA Natural Resources Conservation Service [NRCS] 2021) and the analysis of the effects of those practices are contained in NRCS's Conservation Practice Physical Effects matrices, the Network Effects Diagrams, and in NRCS's Conservation Effects Assessment Project reports. The **Petronila Creek Watershed Nutrient Reduction Initiative** alternative would use USDA CPs related to grazing and croplands to reduce nutrient loads in the Petronila Watershed as those are the primary agricultural uses in the Watershed. In addition, the RP/EA #2 incorporates by reference the analyses from NRCS's December 2019 Environmental Quality Incentives Program Final Programmatic Environmental Assessment (USDA NRCS 2019).

Two USDA CPs, 1) Residue and Tillage Management, No Till and 2) Nutrient Management, are highlighted for the purposes of the RP/EA #2, to provide examples of the types of effects that may result from the application of different types of CPs that are used in grazing and croplands (Appendix E). These two CPs were selected because potential effects are representative of some of the highest impact CPs and implementation of other CPs is anticipated to have lesser effects. Any property selected under the **Petronila Creek Watershed Nutrient Reduction Initiative** alternative would undergo a site-specific environmental review to determine that effects would not exceed those described in this document. Site-specific analyses would be documented in an Environmental Evaluation Worksheet before the action can proceed. The Environmental Evaluation Worksheet would be routed through the Texas TIG to the administrative record, where it would be publicly available. If it is determined that effects would exceed those described in this document, the Texas TIG would either not proceed with that property, or undertake additional site-specific environmental review consistent with NEPA and any other applicable environmental compliance requirements.

The **Petronila Creek Constructed Wetlands Planning** alternative includes only engineering and design activities and is therefore discussed in Section 4.4.

Maps of all three Nutrient Reduction alternatives are provided in Section 3.4.1 to 3.4.3.

4.3.2.1 PHYSICAL RESOURCES

4.3.2.1.1 Geology and Substrates

As described in Section 3.4, the nutrient reduction alternatives proposed under the RP/EA #2 target the main channel and watershed of Petronila Creek, a 44-mile freshwater stream spanning Kleberg and Nueces Counties, located within the Nueces-Rio Grande Coastal Basin.

The **Petronila Creek Watershed Nutrient Reduction Initiative** alternative would implement Residue and Tillage Management, No Till (CP #329) to conserve and improve soil conditions. These actions would be similar in type and scale to typical farmstead operations (e.g., plowing, harvesting, small earthmoving activities, land clearing), which would result in short-term, minor adverse impacts, such as soil erosion, from ongoing tilling and harvesting of croplands. There would be long-term beneficial effects to soils as management practices would reduce sheet and rill erosion, maintain or increase soil organic matter, and increase soil moisture. The Nutrient Management (590) CP would require development and implementation of plans to manage rate, source, placement, and timing of plant nutrients and soil amendments on private landowner agricultural operations and would not be anticipated to affect geology and substrates.

The **Petronila Creek Crooked Ditch Restoration** alternative would require the use of heavy equipment to excavate and grade soils to construct a meandering flow-way ditch and vegetated buffer. Construction activities could include dewatering, excavation and earthmoving, grading, and clearing any existing vegetation as part of channel recontouring. Therefore, short-term, minor adverse effects from erosion and sedimentation could occur during construction. Following construction, however, these areas would be reseeded and planted with native species and wetlands and riparian vegetation would re-establish over time. As such, constructing a vegetated buffer would provide beneficial effects over the long term by reducing erosion and sedimentation to receiving waterways.

These nutrient reduction alternatives would be implemented in accordance with all applicable permits, safety practices, and regulations. SWPPPs, erosion control plans, and spill prevention and response plans would be prepared according to TCEQ standards, including any authorizations related to the National Pollutant Discharge Elimination System (NPDES) and CWA, to minimize erosion.

4.3.2.1.2 Hydrology and Water Quality

The use of heavy equipment to excavate and grade under the **Petronila Creek Crooked Ditch Restoration** alternative could temporarily adversely impact water quality through potential introduction of sediments to adjacent waterbodies during excavation and grading activities. Restoration activities could also alter water temperature if streamside vegetation is modified/removed or introduce contaminants if an accidental spill occurs. Likewise, dewatering could result in increased sediment, elevated pH, and potential introduction of contaminants in impacted waters.

The **Petronila Creek Watershed Nutrient Reduction Initiative** alternative would implement Residue and Tillage Management, No Till (CP #329) to conserve and improve soil conditions. There would be long-term, beneficial effects to hydrology from the reduction of runoff and increased water retention in soils. There could be short-term minor adverse impacts to water quality from ongoing tilling and harvesting of croplands that could result in sedimentation in waterways.

There would be long-term, beneficial effects to water quality from the reduction of runoff, which could prevent sheet and rill erosion and reduce contaminants and sediment in the water. There would be long-term beneficial effects to soils as management practices would reduce erosion overall by maintaining soils on land. The Nutrient Management (590) practice would reduce nutrient, pathogen, and chemical runoff into waterways by managing the timing, source, placement and amounts of fertilizer, manure, soils amendments, and other crop applications. This would result in a long-term benefit to water quality.

However, activities that require grading and excavation would be implemented in accordance with USDA conservation practice standards and specifications (USDA NRCS 2021), as well as standard BMPs (including those described in Appendix B of this document) to avoid or minimize construction runoff, erosion, and sedimentation. Additionally, activities would be relatively small in scale and of short duration. Therefore, adverse impacts to water quality would be localized, short term, and minor. Establishing vegetated buffers, a meandering flow way, and residue tilling would reduce nutrient loading and erosion and improve water quality within Petronila Creek and receiving waters, resulting in a long-term beneficial impact to water quality in the area at the mouth of Petronila Creek.

4.3.2.1.3 Air Quality

Engine exhaust from construction equipment and vehicles associated with the **Petronila Creek Watershed Nutrient Reduction Initiative** and **Petronila Creek Crooked Ditch Restoration** alternatives would involve the use of heavy machinery or farm equipment, which would contribute to an increase in criteria air pollutants, GHGs, and other air pollutants within the Corpus Christi near-nonattainment area for ozone (as described in Section 4.2.1.3). Air emissions would be measurable but localized and temporary, quickly becoming undetectable, and would not exceed CAA *de minimis* criteria for general conformity (40 CFR Section 93.153). With implementation of BMPs, as described in Appendix B of this document, adverse impacts to air quality during construction would be short term and minor.

4.3.2.2 BIOLOGICAL RESOURCES

4.3.2.2.1 Habitats

Construction activities for **Petronila Creek Watershed Nutrient Reduction Initiative** alternative CPs, Residue and Tillage Management, No Till (CP #329) and Nutrient Management (590), would be similar in type and scale to typical farmstead operations (e.g., plowing, harvesting, small earthmoving activities, land clearing, application of fertilizers, etc.). Because the activities would occur in agricultural areas that are already actively managed for grazing or crops, activities would be anticipated to remove only small amounts of native vegetation. These CPs could result in temporary disturbance of native species along wetlands and waterways, but design and construction would be in accordance with USDA conservation practice standards and specifications (USDA NRCS 2021). Standard BMPs, including those described in Appendix B of this document, would be implemented to avoid or minimize potential effects to habitats. Therefore, adverse impacts would be short term and minor.

Impacts on native vegetation for the **Petronila Creek Crooked Ditch Restoration** alternative could also result in short-term minor adverse impacts to wetland and riparian vegetation. Construction activities could include dewatering, excavation and earthmoving, grading, and clearing any existing vegetation as part of channel re-contouring. These activities could adversely affect natural wetlands and result in temporary destruction of native vegetation. Following construction, however, these areas would be reseeded and planted with native species and wetlands and riparian vegetation would re-establish over time. Under both of these alternatives, there could be short-term minor adverse impacts related to the potential to spread non-native species where ground-disturbing activities occur. The design and implementation of both alternatives would be in accordance with USDA conservation practice standards and specifications (USDA NRCS 2021) and standard BMPs, including those described in Appendix B of this document, to avoid or minimize potential for spread of non-native species. Both nutrient reduction alternatives would result in long-term benefits to habitats in the Petronila Watershed by improving watershed conditions and reducing nutrient loads, which would benefit the long-term health of adjacent and downstream habitats.

4.3.2.2.2 Protected Species

Both the **Petronila Creek Watershed Nutrient Reduction Initiative** and the **Crooked Ditch Restoration** alternatives could result in short-term minor adverse impacts to protected species such as whooping crane, northern aplomado falcon, and eastern black rail. These species could be temporarily disturbed or displaced by construction-related human noise and disturbance. These protected bird species could also collide with construction equipment during inclement weather or at night; however, these species are highly mobile and therefore likely capable of avoiding construction equipment. Occurrences of slender rush pea (*Hoffmannseggia tenella*; federally endangered) and South Texas ambrosia (*Ambrosia cheiranthifolia*; federally endangered) have been reported within five miles of both nutrient reduction alternatives on the Texas Natural Diversity database. If individual plant species are present in the proposed work area, grading operations could crush or kill individual plants. BMPs described in Section 6, Appendix A of the Final PDARP/PEIS and BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid or minimize impacts to all protected species during construction (DWH Trustees 2016a). Both nutrient reduction alternatives would result in long-term benefits because a reduction in nutrient loads would benefit downstream waters and wetlands that support protected species.

4.3.2.3 SOCIOECONOMIC RESOURCES

4.3.2.3.1 Cultural Resources

An archaeologist meeting the Secretary of the Interior's Professional Qualification Standards (SOI-qualified) preliminarily reviewed the Texas Archeological Sites Atlas (TASA), a limited-access online database for previously recorded cultural resources surveys and previously identified cultural resources in the vicinity of both nutrient reduction alternatives. For the **Petronila Creek Watershed Nutrient Reduction Initiative** alternative, a limited number of cultural resource surveys have occurred within the area, mostly for road projects. Approximately 100 cultural sites have been identified along Petronila Creek. This area also intersects the King Ranch National Historic District. For the **Petronila Creek Crooked Ditch Restoration** alternative, the majority of the alternative footprint has not been previously surveyed for cultural resources, and no previously recorded cultural resources are mapped. Formal review by DWH cultural resource liaisons would be required to determine whether cultural resources are likely to be present and could be impacted by these alternatives. For both alternatives, the permit applicant or Implementing Trustee would be responsible for ensuring compliance with Section 106 NHPA, 36 CFR Section 800 and 33 CFR Section 325, and Appendix C are complete prior to ground-disturbing activities.

Impacts to cultural resources for the nutrient reduction alternatives would be site specific and would depend on the cultural resources present, their exact nature (the conditions that make the resources eligible for the NRHP, if present), expected impacts, and the regulatory environment. Construction, ground disturbance, or other activities that could potentially alter the historic integrity of any culturally or historically important resources identified during project preparations or predevelopment surveys would be avoided during project implementation. A complete review of all alternatives to satisfy the requirements of NHPA is ongoing and would be completed prior to any activities that would restrict consideration of measures to avoid, minimize, or mitigate any adverse effects on historic properties in the project area. Alternatives would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

4.3.2.3.2 Socioeconomics and Environmental Justice

Implementation of the **Petronila Creek Watershed Nutrient Reduction Initiative** and the **Crooked Ditch Restoration** alternatives could result in short-term, minor, adverse localized disruptions to routine agricultural activities that coincide spatially and temporally with restoration activities. However, landowners who voluntarily participate in the **Petronila Creek Watershed Nutrient Reduction Initiative** alternative would be anticipated to experience long-term socioeconomic benefits due to the implementation of conservation measures that would 1) improve cropland, pasture/grassland, and associated agricultural lands; 2) reduce erosion and the associated costs for maintaining eroded drainage ways; 3) improve production/yield from crops; and 4) increase the farmstead value because of the capital investment in farmstead improvements. The **Crooked Ditch Restoration** alternative would also experience long-term socioeconomic benefits due to reduced erosion and the associated costs for maintaining eroded drainage ways.

Both the **Petronila Creek Watershed Nutrient Reduction Initiative** and the **Crooked Ditch Restoration** alternatives would occur in Kleberg and Nueces Counties, which include both low-income and minority populations.

Analysis methodology of communities with environmental justice concerns is described in Section 4.3.1.3.2. Due to the limited duration and magnitude of impacts, the Texas TIG does not believe that adverse impacts associated with the nutrient reduction alternatives would be disproportionately born by communities with environmental justice concerns or exceed risk levels relative to the general population.

Implementation of BMPs would further reduce the magnitude of these impacts. The Implementing Trustee will conduct outreach that includes strategies to reach low-income and minority populations. Additionally, the Texas TIG will engage with local officials and residents throughout the public involvement process for the RP/EA #2.

4.3.2.3.3 Public Health and Safety

Implementation of both nutrient reduction alternatives would be completed on private land under the guidance of the Implementing Trustee and in accordance with USDA conservation practice standards and specifications (USDA NRCS 2021). There would be long-term benefits to water quality in the watershed, which would reduce risks to public health and safety. In addition, appropriate safety measures would be identified during design and followed during implementation. Therefore, any adverse impacts to public health and safety would be minor and short term.

4.3.2.4 SUMMARY

As described in detail above, the **Petronila Creek Watershed Nutrient Reduction Initiative** alternative would result in the following impacts:

- Physical resources – There would be short-term, minor adverse impacts to geology and water quality through increased soil erosion or sedimentation, as well as via introduction of air pollutants through construction equipment and vehicle engine exhaust. There would be long-term beneficial effects as management practices would reduce nutrient loading and erosion and improve water quality.
- Biological resources – There would be short-term minor adverse impacts to existing habitat, as well as increased risk of non-native species introduction where ground-disturbing activities occur. Protected species could also be temporarily disturbed or displaced as a result of construction-related human noise and disturbance, or could collide with construction equipment during inclement weather or at night. Alternatives would improve watershed conditions and reduce nutrient loads, which would benefit the long-term health of habitats and species.
- Socioeconomic resources – Impacts would be short term, minor, localized disruptions to routine agricultural activities that coincide spatially and temporally with restoration activities. This alternative would not cause disproportionately high and adverse impacts to communities with environmental justice concerns, and any adverse impacts to public health and safety would be minor and short term. Impacts to cultural resources would be site specific and would depend on the cultural resources present, their exact nature (the conditions that make the resources eligible for the NRHP, if present), expected impacts, and the regulatory environment. A complete review of all alternatives to satisfy the requirements of Section 106 of the NHPA is ongoing and would be completed prior to any activities that would restrict consideration of measures to avoid, minimize, or mitigate any adverse effects on historic properties. Over the long term, this alternative would provide socioeconomic benefits by reducing public health and safety risks associated with poor water quality and by improving the yield and value of managed agricultural lands.

The **Petronila Creek Crooked Ditch Restoration** alternative would result in similar beneficial impacts to those discussed for the **Petronila Creek Watershed Nutrient Reduction Initiative** alternative because both alternatives propose to reduce nutrient loads from crop and grazing lands. Both alternatives will impact vegetation. However, the **Petronila Creek Crooked Ditch Restoration** alternative would temporarily remove wetlands and riparian vegetation along a 7.6-mile-long channelized waterway, while activities for the **Petronila Creek Watershed Nutrient Reduction Initiative** alternative would occur primarily in areas that are already actively managed for grazing or crops, with limited amounts of native vegetation. Restoration activities for the **Petronila Creek Crooked Ditch Restoration** alternative could also alter water temperature if streamside vegetation is modified/removed or introduce contaminants if an accidental spill occurs.

4.3.3 Oysters

The **Landscape Scale Oyster Restoration in Galveston Bay** and the **St. Charles Bay Oyster Reef Restoration** alternatives would create new oyster reefs. Both alternatives would use barges for cultch placement at the selected locations. The **Landscape Scale Oyster Restoration in Galveston Bay** alternative would create approximately 50 acres of subtidal and intertidal oyster reefs across the Galveston Bay system. Construction activities would include transporting the cultch material via barges to the site locations. The **St. Charles Bay Oyster Reef Restoration** would create 30 acres of intertidal and subtidal oyster reef habitat by transporting the cultch material via transportation barges and placing mounds of cultch material on selected locations using an excavator from a deck barge.

Maps of each Oysters alternative are provided in Sections 3.5.1 and 3.5.2.

4.3.3.1 PHYSICAL RESOURCES

4.3.3.1.1 Geology and Substrates

Both oyster alternatives could require substrate-disturbing activities (e.g., sediment and cultch placement, construction of oyster reefs, anchoring marker buoys and signs). These reef construction activities would cause localized short-term minor adverse impacts due to placement of anchoring buoys, which would disturb surrounding sediment, and with placement of cultch material, which would disturb and cover the substrates onto which cultch is placed. The **Landscape Scale Oyster Restoration in Galveston Bay** alternative would construct approximately 50 acres of oyster reef, which would require approximately 21,800 CY of cultch. The number and dimensions of the subtidal and intertidal reef mounds have not yet been determined for the **St. Charles Bay Oyster Reef Restoration** alternative but would be dependent on the selected sites' geophysical characteristics and hydrological characteristics. Oyster alternatives would be implemented in accordance with BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs as appropriate and described in Appendix B of this document to minimize substrate impacts during and after construction. Acceptable cultch material could be natural rock, clean concrete, and/or oyster shell. All oyster shell would be sourced from Galveston Bay Foundation's Oyster Shell Recycling Program. The shell would be properly sun-cured for a minimum of six months on land prior to placement.

Restoring oyster habitat would provide long-term benefits associated with increased substrate available for oyster recruitment and reduced wave energy and erosion of nearby shorelines, resulting in stabilized substrates.

4.3.3.1.2 Hydrology and Water Quality

In-water substrate disturbance associated with both oyster alternatives would have short-term, localized, minor adverse impacts to water quality from increases in turbidity. Additionally, vessels and equipment used for construction could leak or discharge oil, fuels, or other fluids. These impacts would be localized and short-term as leaks or discharges would occur rarely, be responded to, as required by law, and dissipate quickly. Oyster alternatives would be implemented in accordance with BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document to minimize impacts due to sediment disturbance, vessel or other equipment discharges, or other seabed-disturbing activities.

The oyster alternatives would have a long-term benefit on water quality due to increased filter feeding by oysters. Placement of oyster reefs would also reduce erosion and stabilize shorelines, resulting in additional long-term water quality benefits.

4.3.3.1.3 Air Quality

Engine exhaust from construction equipment and vehicles associated with both oyster alternatives would contribute to an increase in criteria air pollutants, GHGs, and other air pollutants. The **Landscape Scale Oyster Restoration in Galveston Bay** alternative is proposed within a non-attainment area—the Houston-Galveston-Brazoria 8-hour ozone non-attainment area—while the **St. Charles Bay Oyster Reef Restoration** alternative is located in an attainment area. Air emissions would be measurable but localized and temporary, quickly becoming undetectable, and would not exceed CAA *de minimis* criteria for general conformity (40 CFR Section 93.153). With the implementation of BMPs, as described in Appendix B of this document, adverse impacts to air quality during construction would be short term and minor.

4.3.3.1.4 Noise

Construction activities for both oyster alternatives would include placement of cultch using barges, hauling of cultch material via transportation barges, removal of debris following construction by hand or excavator, transport of personnel conducting project activities, and vehicle and vessel transportation for construction. These activities would increase noise levels above ambient conditions but would be confined to daylight hours and would rapidly diminish over distance from the noise source. Due to the limited duration and extent of noise-generating activities, adverse impacts from noise would be short term and minor.

4.3.3.2 BIOLOGICAL RESOURCES

4.3.3.2.1 Habitats

Construction of oyster reefs under both oyster alternatives would require placement of cultch on the sea floor within coastal bay and nearshore water habitats. Combined, this would result in long-term minor adverse impacts to substrates from the conversion of up to 80 acres of soft mud or sand to hard substrates. Galveston Bay contains abundant soft-substrate areas where seagrass is uncommon, and placement of cultch would not cover existing hard-bottom habitats. Vessels used for construction would increase the risk of spills and could expose marine and benthic habitats in the vicinity to short-term minor increases in motor oil, transmission or other vessel fluids. Increased turbidity from the use of draglines and/or excavators during clutch placement activities would increase turbidity, resulting in short-term minor adverse impacts.

New oyster reefs would have a long-term benefit to benthic and marine habitats by improving the quality of available habitat for aquatic organisms such as fish, crabs, and benthic invertebrates, as well as providing shoreline protection for surrounding intertidal marsh and other habitats.

4.3.3.2.2 Wildlife

No population-level interference to feeding, reproduction, resting, or migration is anticipated for either oyster alternative. Individual birds could be foraging in these offshore, open water locations and displaced to surrounding areas due to human activity and noise. However, ample open water habitat is available in the surrounding area, and these adverse impacts would cease when construction ends. Long-term beneficial effects are anticipated for oyster reproduction and beneficial effects would be anticipated for birds that forage along the shoreline and in open waters because new reef habitats would increase available prey, provide loafing habitat, and provide shoreline protection for surrounding intertidal marsh and other wildlife habitats.

4.3.3.2.3 Marine and Estuarine Resources

Construction of oyster reefs under both oyster alternatives would require placement of cultch and use of equipment and other actions that cause disturbance of the seafloor. These activities would result in minor short-term adverse impacts to marine and estuarine species due to increased turbidity, siltation, entrainment of benthic species, temperature changes, increased biological oxygen demand (due to the introduction of organic matter into water column), decreased dissolved oxygen, vibration, and noise. Cultch placement could smother benthic resources and would convert soft-bottom habitats to hard-bottom habitats, adversely impacting species long term that depend on this habitat. Use of heavy equipment and vessel traffic could also lead to injury or mortality of individuals and could adversely affect essential fish habitat. However, mobile species would likely be capable of avoiding construction activities, resulting in short-term minor displacement. No population-level impacts are anticipated.

Increases in water turbidity during reef construction could disturb feeding or spawning and other behaviors by some estuarine and marine fauna and prey individuals. These would be short-term minor adverse impacts. Implementation of BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and Appendix B of this document would reduce potential effects from construction-related activities and coordination with agencies during E&D could avoid and minimize effects to species. Seagrass is uncommon in Galveston Bay but is known to occur near the shoreline in St. Charles Bay. If seagrasses are found during the site selection process for the **Landscape Scale Oyster Restoration in Galveston Bay** or the **St. Charles Bay Oyster Reef Restoration projects**, measures would also be taken to avoid or minimize impacts.

In the long term, oyster reefs would add habitat complexity and attract new species of organisms, resulting in beneficial changes to the benthic community, such as increased populations of oysters and algae and the species that feed on them (Bulleri and Chapman 2010). The proposed oyster reefs would improve habitat for spawning, nursing, foraging, and shelter of aquatic species. If sites are selected near the shoreline, marshes would receive additional protection against erosion.

4.3.3.2.4 Protected Species

Both oyster alternatives could result in short-term minor adverse impacts to protected sea turtle species, including green sea turtle, hawksbill sea turtle, Kemp’s Ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle, as well as protected marine mammals, including West Indian manatee. Leatherback sea turtles are rare in the northern extent of the Gulf of Mexico and therefore are not expected to be impacted. Construction of oyster reefs would result in seafloor disturbance; would alter the marine environment (see Section 4.3.3.2.3); and would increase human presence, vessel traffic, and noise. These impacts could result in short-term minor disruption or displacement of protected species in the vicinity of construction activities, as well as potential injury or mortality of individuals. However, construction would be immediately halted if sea turtles or marine mammals were spotted near work areas, and work would only resume after the animals had moved away.

There could also be short-term minor adverse impacts to protected species, including nesting birds and wading shorebirds (including protected species such as piping plover, eastern back rail, and red knot) that are present on adjacent shoreline areas. BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document would be implemented to minimize collateral injury for all protected species, including NMFS’s *Measures for Reducing Entrapment Risk to Protected Species* (NMFS 2012), *Vessel Strike Avoidance Measures* (NMFS 2021a), *Protected Species Construction Conditions* (NMFS 2021b), and USACE *Standard Manatee Conditions for In-Water Work* (USACE 2011).

Placement of oyster reefs would add habitat complexity, increase available habitat, and attract new species of reef-attached organisms. This would result in increased populations of benthic communities, oysters and algae, and the species that feed on them (Bulleri and Chapman 2010). Over the long term, this would result in beneficial effects to protected species by increasing prey and other species that are an important part of the food chain for coastal and marine wildlife.

4.3.3.3 SOCIOECONOMIC RESOURCES

4.3.3.3.1 Cultural Resources

Impacts to cultural resources for oyster restoration alternatives would be site specific and would depend on the cultural resources present, their exact nature (the conditions that make the resources eligible for the NRHP, if present), the expected impacts, and the regulatory environment. Formal review by DWH cultural resource liaisons would be required to determine whether cultural resources are likely to be present and could be impacted by the alternatives. The DWH cultural resource liaisons would consult with relevant SHPOs and Tribal Historic Preservation Offices, per Section 106 of the NHPA. The Implementing Trustee would be responsible for ensuring compliance with the Antiquities Code of Texas, Section 106 of the NHPA, 36 CFR Section 800 and 33 CFR Section 325, and Appendix C are complete prior to any seabed-disturbing activities. Construction, ground disturbance, or other activities that could potentially alter the historic integrity of any culturally or historically important resources identified during project preparations or predevelopment surveys would be avoided during project implementation. A complete review of all alternatives to satisfy the requirements of Section 106 of the NHPA is ongoing and would be completed prior to any activities that would restrict consideration of measures to avoid, minimize, or mitigate any adverse effects on historic properties in the project area. Alternatives would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

4.3.3.3.2 Socioeconomics and Environmental Justice

During construction, areas for both oyster alternatives could be temporarily off-limits to use, which could cause minor short-term adverse impacts to some marine users. No adverse economic impacts to commercial fishing activities are anticipated, as any unfishable reefs would be located in areas so degraded that they would not be expected to ever recover naturally and thus are not taken out of production. Short-term beneficial effects to local and regional economies could occur from construction-related employment to implement the oyster alternatives. These jobs would likely provide income, sales, and economic activity in the immediate area. The oyster alternatives would also enhance fishing in the vicinity of the constructed reef structures, resulting in long-term socioeconomic benefits.

Oyster alternatives would occur in proximity to one county with low-income and/or minority populations: Harris County. Analysis methodology of communities with environmental justice concerns is described in Section 4.3.1.3.2. Due to the limited duration and magnitude of impacts, the Texas TIG does not believe that adverse impacts associated with the oyster alternatives would be disproportionately born by communities with environmental justice concerns or exceed risk levels relative to the general population. Implementation of BMPs would further reduce the magnitude of these impacts. The Implementing Trustee will conduct outreach that includes strategies to reach low-income and minority populations. Additionally, the Texas TIG will engage with local officials and residents throughout the public involvement process for the RP/EA #2.

4.3.3.3.3 Tourism and Recreational Use

Both oyster alternatives could result in minor short-term adverse impacts to tourism and recreation use in the vicinity of construction areas due to construction noise, equipment, and human activities. These impacts would cease when construction is complete. Long-term beneficial effects would be expected due to increased recreational fishing around both oyster alternatives.

4.3.3.3.4 Aesthetics and Visual Resources

Construction activities for both oyster alternatives would have a minor short-term adverse impact on aesthetics and visual resources in Upper Galveston Bay, Trinity Bay, and St. Charles Bay due to views of barges, excavators, and workers at restoration sites. These impacts would cease when construction is complete. Over the long term, oyster reef restoration would enhance observable wildlife variety and abundance, which would benefit aesthetics and visual resources.

4.3.3.3.5 Infrastructure

The oyster alternatives would involve construction activities in submerged areas. Short-term minor adverse impacts could include physical damage or disruption of subsea infrastructure. However, alternatives would be sited to avoid destroying, damaging, burying, or exposing existing subsea pipelines, cables, and other existing infrastructure to the extent possible in accordance with state law and the applicable RMCs and BMPs, as applicable and disclosed in Appendix B of this document.

Over the long term, oyster alternatives would improve shoreline integrity and provide a buffer against potential hazards (i.e., storm surge, sea level rise, flooding). These beneficial actions would provide greater longevity for existing infrastructure on the landward side of oyster reefs.

4.3.3.3.6 Fisheries and Aquaculture

Oyster alternatives would not result in long-term adverse impacts to commercial fisheries or aquaculture operations. In the short term, water quality could be affected due to construction of in-water components. All construction adverse impacts would be short term and minor. As discussed in Section 4.3.3.3.2, no reductions in harvest are anticipated due to placement of reefs outside harvestable areas. Under the **Landscape Scale Oyster Restoration in Galveston Bay** alternative, long-term, oyster reef enhancements would increase oyster recruitment, resulting in improved regional commercial shellfish harvest opportunities through larval supply and transport.

4.3.3.3.7 Marine Transportation

During construction of both oyster alternatives, the presence of construction vessels and platforms would result in a minor short-term adverse impact to navigation in the area. However, staging and anchoring areas would be sufficiently offset from any navigation channels, so that there would be sufficient space for recreational and larger commercial vessels to avoid construction equipment and vessels. Multiple construction activities occurring in the same area would be completed in phases or coordinated, to the extent practicable, to minimize vessel-related accidents and conflicts.

Once installed, submerged oyster reefs could also result in changes to marine navigation safety and routes. However, standard USCG requirements would be implemented, such as notices to mariners, temporary lights on equipment and material barges, and/or use of signage or navigational aids on submerged structures and reefs. Required signage would not be located within any local navigation channel, either maintained or natural. New reefs would be added to navigation charts to avoid possible navigation impacts. Additionally, specific areas for oyster reefs would be sited to avoid existing navigation channels. Therefore, adverse impacts would be long term but minor.

4.3.3.3.8 Public Health and Safety

During construction of oyster reefs, the operation of heavy equipment and offshore vessels could result in short-term minor adverse impacts to public health and safety. Navigation impacts are discussed in Section 4.3.3.3.7. If hazardous chemicals or other materials are unintentionally released into the environment, surrounding substrate and waters could be adversely impacted in the area. However, any hazardous materials used during construction would be contained, and appropriate BMPs, as described in Appendix B of this document, would be implemented to protect health and safety.

Once construction is complete, both oyster alternatives would provide long-term benefits to public health and safety by 1) improving water quality through increased filtration of pollutants by oysters, and 2) providing a buffer against potential hazards (i.e., storm surge, wave action), resulting in greater community resilience.

4.3.3.4 SUMMARY

As described in detail above, the **Landscape Scale Oyster Restoration in Galveston Bay** alternative would result in the following impacts:

- Physical resources – There would be short-term, minor adverse impacts to physical resources through substrate disturbance and sedimentation, turbidity and/or equipment leaks/discharges in the water column during cultch reef placement activities as well as via introduction of noise and air pollutants through construction equipment and vehicle engine exhaust. Long-term beneficial effects to water quality would occur from oyster filter feeding and increased substrate available for oyster recruitment that reduce wave energy and erosion of nearby shorelines.
- Biological resources –There would be short-term minor adverse impacts to existing aquatic habitat from construction turbidity and potential leaks that could disturb feeding or spawning and other behaviors by some estuarine and marine fauna. Protected species could be temporarily disturbed or displaced as a result of construction-related human noise and disturbance. Long-term benefits would occur from adding habitat complexity, increasing populations of oysters and algae, improving habitat for spawning, nursing, foraging, and shelter and provision of nearby marsh protection.
- Socioeconomic resources – There would be short-term, minor, localized disruptions to tourism and recreation use in the vicinity of construction areas due to construction noise, equipment, and human activities. This alternative would not cause disproportionately high and adverse impacts to communities with environmental justice concerns, and any adverse impacts to public health and safety would be minor and short term. Impacts to cultural resources would be site specific and would depend on the cultural resources present, their exact nature (the conditions that make the resources eligible for the NRHP, if present), expected impacts, and the regulatory environment. A complete review of all alternatives to satisfy the requirements of Section 106 of the NHPA is ongoing and would be completed prior to any activities that would restrict consideration of measures to avoid, minimize, or mitigate any adverse effects on historic properties. Over the long term, this alternative would provide socioeconomic benefits by 1) improving water quality; 2) reducing coastal infrastructure risks associated sea level rise and storm surges; and 3) enhancing recreational activities such as fishing.

The **St. Charles Bay Oyster Reef Restoration** alternative would result in similar adverse and beneficial impacts to those discussed for the **Landscape Scale Oyster Restoration in Galveston Bay** alternative because both alternatives propose to create new oyster reefs.

4.3.4 Sea Turtles

The three sea turtle alternatives considered in the RP/EA #2 involve a range of restoration activities. The **Lancha Sea Turtle Mitigation Plan** alternative proposes to purchase long-range vessel(s) and enhance enforcement and/patrol efforts to apprehend illegal vessels and remove illegal fishing gear from the water. In addition, the alternative may result in the procurement of dock space for vessel(s) used for this project and the installation of a floating dock for those vessel(s)The **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative would result in the construction of a sea turtle rehabilitation facility and parking lot on a previously disturbed area historically used as a dredge placement site directly northwest of the TAMUG Campus Wetland Center. The **Kemp's Ridley Sea Turtle Nest Protection** alternative proposes to enhance nest detection and protection activities already underway along the Texas Gulf Coast and would also implement adult sea turtle satellite tracking activities.

Maps of each sea turtle alternative are provided in Sections 3.6.1 to 3.6.3.

4.3.4.1 PHYSICAL RESOURCES

4.3.4.1.1 Geology and Substrates

The **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative would involve terrestrial ground-disturbing activities from use of heavy equipment for excavation and grading on a 2-acre dredged material placement site, which would potentially increase short-term erosion or compaction during construction. The construction of a new facility on a dredged material disposal site would result in long-term minor loss of soil productivity within the permanent facility foundation footprint and related infrastructure (e.g., parking). Construction would be conducted in accordance with all applicable permits, safety practices, and regulations and in accordance with BMPs in Appendix B of this document to avoid or minimize impacts to geology and soils.

Nest protection activities (beach patrols and sea turtle tracking) proposed as part of the **Kemp's Ridley Sea Turtle Nest Protection** alternative could result in short-term minor adverse impacts to beach substrates in some areas as a result of sediment disturbance by people and vehicles.

Floating dock installation for the **Lancha Sea Turtle Mitigation Plan** would result in long-term, minor adverse impacts to substrates where the floating dock is connected to the shore, where poles are sledge hammered into the sediment to anchor the dock in place, and from any associated steps and handrails that could be constructed.

4.3.4.1.2 Hydrology and Water Quality

During construction, the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative would involve ground-disturbing activities, which could potentially increase stormwater runoff volume, sedimentation, and transport of stormwater pollutants during construction. Vessels used for enforcement activities under the **Lancha Sea Turtle Mitigation Plan** alternative could leak or discharge oil, fuels, or other fluids into waters of the Gulf of Mexico. These impacts would be localized and short term as leaks or discharges would occur rarely, be responded to in accordance with the law, and dissipate quickly. Additionally, vessels will be regularly maintained, which will help minimize leaks and discharges. Dock installation would be conducted in accordance with all applicable permits, safety practices, and regulations, including any authorizations pursuant to the NPDES and CWA. In addition, any BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid or minimize potential effects to water quality. With implementation of these BMPs, adverse impacts to water quality during construction or from vessel or other equipment discharges would be short term and minor.

4.3.4.1.3 Air Quality

The **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative is proposed in the Houston-Galveston-Brazoria 8-hour ozone nonattainment area. Engine exhaust from construction equipment and vehicles associated with construction of this alternative would contribute to an increase in criteria air pollutants, GHGs, and other air pollutants in the Houston-Galveston-Brazoria 8-hour ozone nonattainment area. These emissions would be measurable but localized and temporary, quickly becoming undetectable, and would not exceed CAA *de minimis* criteria for general conformity (40 CFR Section 93.153). With implementation of BMPs, as appropriate and described in Appendix B of this document, adverse impacts to air quality during construction would be short term and minor. Air emissions associated with the vessel trips proposed for the **Lancha Sea Turtle Mitigation Plan** alternative would occur in marine areas where patrols are occurring. Additionally, air emissions may occur while procuring materials for the dock and during dock installation. The **Kemp's Ridley Sea Turtle Nest Protection** alternative could increase air emissions from use of UTVs. These adverse effects would be short term and minor.

4.3.4.1.4 Noise

Construction of the **Upper Texas Coast Sea Turtle Rehabilitation Facility** would generate noise from heavy equipment use and worker vehicle trips associated with clearing and grading the site for the construction of the facility and parking area, and other related activities. These noise sources would be noticeable but restricted to daylight hours and would decrease rapidly over distance from the noise source. Therefore, adverse construction impacts would be short term, minor, and end once construction was completed. Operation of the facility would also generate long-term noise from vehicle traffic, although levels would likely be similar to current traffic activity. Noise associated with the vessel proposed for the **Lancha Sea Turtle Mitigation Plan** alternative would occur in marine areas where patrols are occurring and would be consistent with typical vessel noise in the Gulf of Mexico. Minor noise could occur during installation of the dock. The **Kemp's Ridley Sea Turtle Nest Protection** alternative could increase noise from use of UTVs and personnel carrying out nest protection activities. These adverse effects would be short term and minor.

4.3.4.2 BIOLOGICAL RESOURCES

4.3.4.2.1 Habitats

The **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative would permanently convert approximately two acres of upland scrub-shrub habitat within the facility footprint to developed land. Because the facility is proposed to be located in an existing dredge spoil area, habitat values are limited and will not be impacted by construction. Based on the availability of coastal upland and marsh habitats in the vicinity of the proposed **Upper Texas Coast Sea Turtle Rehabilitation Facility** and the quality of the habitat being converted, adverse impacts would be long term but minor.

The **Lancha Sea Turtle Mitigation Plan** may involve the acquisition and installation of a floating dock for the vessel(s). The floating dock(s) could be anchored in place either in water or on land, via poles hammered into the ground with sledgehammers. The anticipated location of the dock(s) would be in or adjacent to areas of developed waters such as marinas or ports. Although some shading of the seabed would occur, since the dock(s) would be adjacent to developed waters, the likelihood of seagrass being present is low, and areas with seagrass would be avoided. Adverse impacts as a result of dock installation and operation would be long term but minor and would be limited to a small geographic footprint.

Increased foot and vehicular traffic associated with nest protection activities for the **Kemp's Ridley Sea Turtle Nest Protection** alternative could result in short-term minor adverse impacts to beach habitats in some areas.

4.3.4.2.2 Wildlife

Construction equipment and vehicle traffic noise for the **Upper Texas Coast Sea Turtle Rehabilitation Facility** could disturb wildlife, migratory birds, and shorebirds, resulting in short-term displacement that will end with the completion of construction. Ground-clearing activities also could result in displacement, injury, or mortality of individual small reptiles and mammals. However, the effect would be localized and would not result in population-level impacts. Birds and other mobile animals would likely be capable of relocating to other suitable areas for nesting, resting, and foraging habitats. Long-term loss of two acres of upland habitat would represent a minor adverse impact. All appropriate BMPs would be followed to minimize disturbance on wildlife species (see Appendix B of this document).

Implementation of the **Lancha Sea Turtle Mitigation Plan** alternative could result in long-term, minor adverse impacts to wildlife species that use the area where the dock would be installed, both during installation and as boats operate in the area. Since the dock would be in an already disturbed and regularly trafficked area, the disturbance would be expected to be minimal.

4.3.4.2.3 Marine and Estuarine Resources

Implementation of the **Lancha Sea Turtle Mitigation Plan** alternative could result in short-term, minor adverse impacts to marine species that use or transit through the floating dock area or targeted patrol area via temporary disturbance or displacement due to noise and vibration or changes to water quality (via accidental spills). BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid or minimize impacts to marine species.

Long term benefits of increased enforcement actions could result in the reduction of illegal fishing by removing illegal fishing gear and vessels and releasing any live species caught by illegal means, which could benefit multiple marine species long term that are known to become caught in lancha gear, including sea turtles, red snapper, sharks, and dolphins.

4.3.4.2.4 Protected Species

Most protected species would not be impacted, as the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative would involve terrestrial ground-disturbing activities in upland areas. However, short-term minor adverse impacts to protected nesting birds (piping plover and red knot) could occur as a result of vegetation removal, noise disturbance, dust, and increased human activity during construction activities. BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid or minimize impacts to protected species. These adverse impacts would end with construction. Although sea turtles could experience short-term minor adverse impacts due to handling and transfer to the rehabilitation facility, this alternative would result in long-term beneficial impacts to sea turtle survival and reproduction capacity.

The **Kemp's Ridley Sea Turtle Nest Protection** alternative could result in short-term minor adverse impacts to protected species that occur along beaches. Protected shorebirds are highly mobile and are likely capable of avoiding patrol activities. As sea turtles would be the focus of beach patrols, it is highly unlikely that a collision with patrol vehicles would occur. Nest protection and tracking activities (e.g., disturbance or relocation of nests) have been successfully implemented for decades with little harm to sea turtles. Project partners would adhere to all established research protocols, permit requirements, and best practices for conducting fieldwork on sea turtles and in sea turtle nesting environments to ensure that collateral injury is avoided. Furthermore, BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid and minimize impacts to protected species. This alternative would result in beneficial long-term impacts to sea turtle populations by increasing nesting success and hatchling survivorship.

Enforcement and patrol efforts for the **Lancha Sea Turtle Mitigation Plan** alternative would produce noise from vessel operations in the marine areas where patrols are occurring and potentially during dock installation. This noise and human activity could result in short-term minor disturbance or displacement of marine species such as sperm whale, West Indian manatee, giant manta ray, green sea turtle, hawksbill sea turtle, Kemp's Ridley sea turtle, loggerhead sea turtle, and leatherback sea turtle. Patrols could also potentially introduce contaminants (oil, fuel, etc.) in cases of accidental vessel leaks. However, vessel-wildlife interactions are likely to be very low given the frequency of patrols, the size of targeted patrol area, and the general mobility of protected species. BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document or other regulatory documents could be implemented to minimize collateral injury, including NMFS's *Measures for Reducing Entrapment Risk to Protected Species* (NMFS 2012), *Vessel Strike Avoidance Measures* (NMFS 2021a), *Protected Species Construction Conditions* (NMFS 2021b), and USACE *Standard Manatee Conditions for In-Water Work* (USACE 2011). Furthermore, this alternative would result in long-term beneficial impacts to sea turtle conservation, as well as potentially other protected species, by reducing injury and mortality and preventing future illegal fishing operations.

4.3.4.3 SOCIOECONOMIC RESOURCES

4.3.4.3.1 Cultural Resources

An SOI-qualified archaeologist preliminarily reviewed the TASA for previously recorded cultural resources surveys and previously identified resources in the vicinity of the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative. No portion of the alternative footprint has been previously surveyed for cultural resources, and no cultural resources are mapped. However, the alternative is on reclaimed land that was once tidal flats or shallow waters; these areas have a potential for unmapped, deeply buried cultural resources. At least two shipwrecks have been mapped off the coast of Pelican Island. A formal review by DWH cultural resource liaisons is required to determine whether cultural resources are likely to be present and could be impacted by these alternatives.

As the proposed facility would be constructed on land owned or controlled by TAMUG, a political subdivision of the state of Texas, the alternative would be required to comply with the Antiquities Code of Texas, providing a level of protection for cultural resources. The Implementing Trustee would be responsible for ensuring compliance with Section 106 of the NHPA, 36 CFR Section 800 and 33 CFR Section 325, and Appendix C prior to ground-disturbing activities.

Impacts to cultural resources for the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative would depend on the cultural resources present, their exact nature (the conditions that make the resources eligible for the NRHP, if present), the expected impacts, and the regulatory environment. Construction, ground disturbance, or other activities that could potentially alter the historic integrity of any culturally or historically important resources identified during project preparations or predevelopment surveys would be avoided during project implementation. A complete review of all alternatives to satisfy the requirements of Section 106 of the NHPA is ongoing and would be completed prior to any activities that would restrict consideration of measures to avoid, minimize, or mitigate any adverse effects on historic properties in the project area. Alternatives would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

4.3.4.3.2 Socioeconomics and Environmental Justice

No adverse impacts to socioeconomic resources are anticipated as a result of the **Lancha Sea Turtle Mitigation Plan** alternative. As noted in the Final PDARP/PEIS (DWH Trustees 2016a), steady, consistent enforcement efforts would reduce conflict among legal and illegal fishers, resulting in a long-term socioeconomic benefit. Short- to long-term benefits to the local and regional economies could also occur from construction- and operation-related employment for the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative. The **Kemp's Ridley Sea Turtle Nest Protection** alternative would additionally provide opportunities for local volunteer organizations to assist with sea turtle conservation.

Sea turtles alternatives would occur in or adjacent to a 17-county analysis area, which include a mix of both low-income and minority populations. Analysis methodology of communities with environmental justice concerns is described in Section 4.3.1.3.2. Due to the limited duration and magnitude of impacts, the Texas TIG does not believe that adverse impacts associated with the sea turtles alternatives would be disproportionately born by communities with environmental justice concerns or exceed risk levels relative to the general population. Implementation of BMPs would further reduce the magnitude of these impacts. The Implementing Trustee will conduct outreach that includes strategies to reach low-income and minority populations. Additionally, the Texas TIG will engage with local officials and residents throughout the public involvement process for the RP/EA #2.

4.3.4.3.3 Tourism and Recreation Use

Restoration activities in the **Lancha Sea Turtle Mitigation Plan** and **Kemp's Ridley Sea Turtle Nest Protection** alternatives could result in short-term localized minor adverse impacts to Gulf Coast tourism and recreational activities from noise associated with the implementation of the alternatives along the Gulf Coast. However, implementation of the **Lancha Sea Turtle Mitigation Plan, Upper Texas Coast Sea Turtle Rehabilitation Facility,** and **Kemp's Ridley Sea Turtle Nest Protection** alternatives would support long-term wildlife conservation, which could lead to beneficial impacts to tourism and recreation related to wildlife viewing. Increased enforcement as a part of the **Lancha Sea Turtle Mitigation Plan** alternative would also result in reduced conflict among legal and illegal fishers in state and federal waters.

4.3.4.3.4 Aesthetic and Visual Resources

During construction of the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative visual resources and aesthetics could be affected by views of construction activity. The site is previously disturbed and located directly northwest of the TAMUG Campus Wetlands Center, so the proposed facility would be consistent with the partially developed visual character of the immediate area and would not dominate the existing aesthetics. Any disturbed areas that are not within the construction footprint would be revegetated with native species following construction. Therefore, adverse impacts to aesthetics and visual resources would be short term and minor.

4.3.4.3.5 Fisheries and Aquaculture

Adverse effects to fisheries from the **Lancha Sea Turtle Mitigation Plan** alternative are not expected. Reductions in illegal fishing would provide a long-term benefit to legal commercial fishing operations that overlap with the targeted patrol area.

4.3.4.3.6 Public Health and Safety

Construction activities related to the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative, such as operation of heavy equipment and increased vehicle traffic, could increase health and safety risks for adjacent communities. However, BMPs, as described in Appendix B of this document, would be implemented to avoid and minimize potential impacts to water and air quality, as well as to safely manage hazardous materials. Therefore, these impacts would be short term and minor.

4.3.4.4 SUMMARY

As described in detail above, the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative would result in the following impacts:

- Physical resources – There would be short- to long-term minor adverse impacts to geology and substrates and hydrology and water quality through soil erosion, compaction, or loss of soil productivity, as well as potential increased stormwater runoff volume, sedimentation, and transport of stormwater pollutants. This alternative would also result in short-term minor adverse impacts due to air emissions and noise generated by construction equipment and vehicles.
- Biological resources – There would be short- to long-term minor adverse impacts to habitats and wildlife due to habitat conversion, wildlife disturbance, or displacement.
- Socioeconomic resources –There would be short-term minor adverse aesthetic changes during construction, as well as public health and safety risks due to operation of heavy equipment and increased vehicle traffic. No disproportionately high and adverse impacts to minority populations and low-income populations are anticipated. This alternative would provide a short-term benefit by generating construction-related employment and spending.

As described in detail above, the **Lancha Sea Turtle Mitigation Plan** alternative would result in the following impacts:

- Physical resources – There would be short or long-term, minor adverse impacts to substrates where the floating dock is connected to the shore and anchored by poles into the sediment, as well as short-term minor adverse impacts to hydrology and water quality through potential vessel leaks or dock installation. This alternative would also result in short-term minor adverse impacts due to air emissions and noise generated by the operating vessel(s) or dock installation.
- Biological resources – There could be short or long-term minor adverse impacts to habitats and wildlife due to shading. However, locations with seagrass would be avoided. Short or long-term minor adverse impacts could occur from disturbance associated with the potential installation and operation of a new dock(s), and short-term minor adverse impacts to marine and estuarine resources or other protected species due to temporary disturbance or displacement due to noise and vibration or changes to water quality. Action could benefit multiple marine species long term that are known to become caught in lancha gear, including sea turtles, red snapper, sharks, and dolphins.
- Socioeconomic resources – No adverse impacts to aesthetics, public health and safety, or communities with environmental justice concerns are anticipated. This alternative would provide a long-term benefit by reducing illegal harvest of Texas resources and supporting long-term wildlife conservation, which could lead to beneficial impacts to tourism and recreation use related to wildlife viewing.

As described in detail above, the **Kemp's Ridley Sea Turtle Nest Protection** alternative would result in the following impacts:

- Physical resources – There would be short-term minor adverse impacts to geology and substrate through sediment disturbance by people and vehicles. This alternative would also result in short-term minor adverse impacts due to air emissions and noise generated by UTVs and personnel carrying out nest protection activities.
- Biological resources – There would be short-term minor adverse impacts to beach habitats, wildlife, and protected species due to temporary foot and vehicle traffic, or wildlife disturbance or displacement due to noise and human activity.
- Socioeconomic resources – No disproportionately high and adverse impacts to communities with environmental justice concerns are anticipated. This alternative would provide a long-term benefit by 1) providing opportunities for local volunteer organizations to assist with sea turtle conservation and 2) supporting long-term wildlife conservation, which could lead to beneficial impacts to tourism and recreation use related to wildlife viewing.

4.3.5 Birds

Three of the Bird alternatives, the **Jones Bay Oystercatcher Habitat Restoration**, **San Antonio Bay Bird Island**, and **Gulf Cut Bird Islands Restoration** alternatives (hereinafter **Bird Islands** alternatives) would restore or create bird habitat. The **Jones Bay Oystercatcher Habitat Restoration** would restore a total of about one acre of nesting habitat on five small existing islands and create six intertidal reef sites totaling approximately 1.5 acres to support foraging needs for American oystercatchers (and other birds). The **San Antonio Bay Bird Island** alternative would construct approximately four acres of habitat above the shoreline and approximately one acre of submerged reef habitat to protect the island. The **Gulf Cut Bird Islands Restoration** alternative would restore approximately six acres of former reef rake islands to increase available nesting habitat for ground nesting waterbirds in East Matagorda Bay, Texas. The **Laguna Vista Rookery Island Habitat Protection** alternative would complete engineering and construct approximately 2,250 LF of living shoreline to minimize ongoing erosion and restore the shoreline along the perimeter of the 11-acre Spoil Island located in the Lower Laguna Madre. The **Texas Breeding Shorebird and Seabird Stewardship** alternative would identify nesting beaches to be targeted for outreach and education to landowners and the public on nesting needs of birds on beaches, install symbolic fencing and signage to protect high-use nesting areas, conduct patrols by stewards, and collect breeding bird and nesting success data at designated sites.

Maps of each Bird alternative are provided in Sections 3.7.1 to 3.7.5.

4.3.5.1 PHYSICAL RESOURCES

4.3.5.1.1 Geology and Substrates

The **Jones Bay Oystercatcher Habitat Restoration**, **San Antonio Bay Bird Island**, and **Gulf Cut Bird Islands Restoration** alternatives (hereinafter **Bird Islands** alternatives) would impact subtidal bay bottoms of unconsolidated sands, silts, and clay. The alternatives would restore or create new bird islands using dredged material to achieve elevations that are less susceptible to extreme overwash, wave energy, and erosional forces. During construction, short-term minor substrate disturbance could occur from vessel or equipment activity. Placement of fill materials for island, or associated reef/breakwater creation, would also cover existing sediments, resulting in long-term minor alteration of existing substrate within the component footprint. Fill material for the **Jones Bay Oystercatcher Habitat Restoration** alternative and the **San Antonio Bay Bird Island** alternative would be obtained from an approved outside source, dredged material placement area, in situ bay location, or from sediments sourced from a nearby navigation project. Fill material would be chemically analyzed prior to ensure that no contaminants are present. The **Gulf Cut Bird Island** alternative would use limestone rock and cultch material and place it in shallow waters surrounding the island. The **San Antonio Bay Bird Island** alternative would also include construction of an approximately 1-acre reef to protect the island, which would convert existing substrate to hard structure. Likewise, the **Jones Bay Oystercatcher Habitat Restoration** alternative would construct approximately 1.5 acres of intertidal reef near each island using limestone cultch. A rock breakwater (approximately 300 LF) could also installed at one island site. BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B in this document, would be implemented to avoid and minimize impacts to geology and substrates. Once installed, these alternatives would result in long-term benefits to geology and soils by reducing soil loss and erosion at bird islands and adjacent shorelines.

The **Texas Breeding Shorebird and Seabird Stewardship** alternative would result in short-term minor adverse impacts to substrates due to installation of fencing and signage, as well as from increased vehicle and pedestrian foot traffic during implementation. However, this alternative could lead to long-term benefits to substrates by restricting or controlling foot and vehicle access through stewardship measures, including BMPs, as appropriate and described in Appendix B in this document, which would help to prevent soil disturbance.

The **Laguna Vista Rookery Island Habitat Protection** alternative would construct an approximately 2,250-linear-foot living shoreline to protect the island. Construction of the living shoreline would require placement of approximately 2,300 cubic yards of limestone or clean riprap on the seafloor, and on approximately 550 LF (700 cubic yards) of riprap revetment would be placed along the eroding southern shoreline. This would result in the long-term minor disturbance of substrate and soils on the eroding southern shoreline. During construction, heavy equipment such as barges and excavators would be used, which could lead to disturbance of geology and substrates outside the footprint of the living shoreline. These would be short-term minor adverse impacts, and areas would be either regraded postconstruction or would settle out in the marine environment once construction activities were completed. Dredging of an approximately 1,800 linear foot floatation channel necessary for construction access would result in short-term minor adverse impacts to the substrate in the floatation channel footprint. The dredged material could be used as fill for the living shoreline if deemed suitable for reuse. Material reused elsewhere and not replaced in the floatation channel would result in a long-term minor adverse impact. Grading of in situ material (approximately 250 cubic yards) to restore scarped shoreline areas along the island shoreline shoreward of the nearshore breakwaters would also result in short-term minor adverse impacts to geology and substrates. However, this activity would occur primarily above the mean high-water elevation and would include the planting of native vegetation to stabilize the regraded shoreline. BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a), and BMPs, as appropriate and described in Appendix B in this document, would be implemented to avoid or minimize impacts to geology and substrates. Geology and substrates would benefit over the long term due reduced wave energy and shoreline erosion, resulting in stabilized substrates.

4.3.5.1.2 Hydrology and Water Quality

In-water disturbance and placement of material on the seafloor associated with the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives would have short-term localized minor adverse impacts to water quality from increases in turbidity. Additionally, vessels and equipment used for construction could leak or discharge oil, fuels, or other fluids. These impacts would be localized and short term, as leaks or discharges would rarely occur, be responded to quickly, as provided by law, and would dissipate quickly. The source of fill used for construction would be chemically analyzed prior to construction to ensure that no contaminants are present. Further, the use of a containment berm for the

Bird Islands alternative would contain loose soils and reduce turbidity. The **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives would be implemented in accordance with BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document to minimize impacts on hydrology and water quality due to sediment disturbance, vessel or other equipment discharges, or other seabed-disturbing activities. Decreased erosion and sedimentation from shoreline protection under the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives would result in long-term benefits to water quality.

4.3.5.1.3 Air Quality

All bird alternatives are in attainment areas. Engine exhaust from construction equipment and vehicles associated with the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives would contribute to an increase in criteria air pollutants, GHGs, and other air pollutants. These emissions would be measurable but localized and temporary, quickly becoming undetectable, and would not exceed CAA *de minimis* criteria for general conformity (40 CFR Section 93.153). With implementation of BMPs, as described in Appendix B of this document, adverse impacts to air quality during construction would be short term and minor.

4.3.5.1.4 Noise

Construction activities for the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives would include transporting riprap, dredged material, and other construction-related items via transportation barges to the restoration locations. Placement of materials for island creation and living shoreline and revetment construction would also require use of heavy equipment that would generate noise. These activities would increase noise levels above ambient conditions but would be confined to daylight hours and would rapidly diminish over distance from the noise source. Due to the limited duration and extent of noise-generating activities, adverse impacts from noise would be short term and minor.

4.3.5.2 BIOLOGICAL RESOURCES

4.3.5.2.1 Habitats

Existing habitats affected by the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives include subtidal bay bottoms of unconsolidated sands, silts, and clay. Within proposed alternative footprints, the habitats that comprise these areas would be permanently changed. Creation of bird islands would convert open water habitats to upland habitats, while breakwater construction would convert soft-bottom habitats to hard-bottom habitats. Because ample open water and soft-bottom habitat is available in the surrounding area, however, this would be a long-term minor adverse impact. Shoreline and upland habitats associated with the **Laguna Vista Rookery Island Habitat Protection** alternative would also experience short-term minor adverse impacts during construction of the revetment and the shoreline stability grading effort. Ground-disturbing activities could increase the risk of non-native species introduction. However, all temporarily disturbed areas would be replanted with native vegetation. The **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives would be implemented in accordance with BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document to minimize impacts habitats during construction.

Construction and enhancement of bird islands would increase upland habitat for birds and other terrestrial species, as well as shallow water estuarine areas that provide habitat for juveniles and feeding for some species of fish and shellfish. Placement of the living shoreline, breakwater, revetment, and reef would add habitat complexity that would benefit benthic species and provide prey/feeding areas for other marine species. These outcomes represent a long-term benefit, particularly because these areas would be reachable only by boat, which reduces opportunities for human-related disturbance.

The **Texas Breeding Shorebird and Seabird Stewardship** alternative could have short-term minor adverse impacts on habitats where installation of fencing and signage occurs.

4.3.5.2.2 Wildlife

Construction of the **Bird Islands** alternatives, as well as construction of a living shoreline, placement of revetment, shoreline regrading, and/or creation of a floatation channel. The **Laguna Vista Rookery Island Habitat Protection** alternative, would affect upland, coastal, and open water marine habitats in the vicinity of the work areas. These areas are used by wildlife, including migratory birds, for foraging, nesting, or loafing. Noise from the construction equipment and any ground-clearing activities could result in disturbance or displacement of individuals; open water activities would limit the availability of these areas to birds for foraging. These would be considered short-term minor adverse impacts that, while detectable, would be localized and would not result in population-level impacts. Birds and other mobile animals would likely be capable of relocating to other suitable areas for nesting, resting, and foraging habitats. These alternatives would be implemented in accordance with BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document to minimize impacts to wildlife and birds during construction. Restoration actions would improve the quality of available habitat for shorebirds, rookeries, and other wildlife, resulting in a long-term benefit.

Implementation of the **Texas Breeding Shorebird and Seabird Stewardship** alternative would potentially have short-term minor adverse impacts to wildlife, including birds, due to human activity and noise. However, these impacts would cease as soon as activities are complete. Stewardship activities are intended to provide protection and conservation for nesting birds and would encourage long-term benefits to birds by increasing nest success and productivity.

4.3.5.2.3 Marine and Estuarine Resources

Construction activities for the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives would result in minor short-term adverse impacts to marine and estuarine species due to increased turbidity, siltation, entrainment of benthic species, temperature changes, increased biological oxygen demand due to the introduction of organic matter into the water column, decreased dissolved oxygen, vibration, and noise. The placement of both fill and rock could smother benthic resources and would convert soft-bottom habitats to hard-bottom habitats, adversely impacting species long term that depend on this habitat. The use of heavy equipment and vessel traffic could also potentially lead to injury or mortality of individuals and could also adversely affect EFH. However, more mobile species would likely be capable of avoiding construction activities, resulting in short-term minor displacement. No population-level impacts are anticipated.

Increases in in-water turbidity during breakwater construction could disturb feeding or spawning and other behaviors by some estuarine and marine fauna and prey individuals. However, similar marine and estuarine habitat is available if individuals are displaced into surrounding areas, and turbidity levels would return to preconstruction conditions once construction ends; therefore, these would be short-term minor adverse impacts. BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a) and BMPs, as appropriate and described in Appendix B of this document would be implemented to reduce potential effects from construction-related activities. If submerged aquatic vegetation is found, measures would also be taken to avoid or minimize impacts.

In the long term, by adding habitat complexity and attracting new species of attached organisms, beneficial changes to the benthic community could occur, such as increased populations of oysters and algae and the species that feed on them (Bulleri and Chapman 2010). Additionally, creation of bird islands could increase available shallow water estuarine areas, which provide habitat for juveniles and feeding for some species of fish and shellfish. The creation of hard substrate may improve the quality of habitat for some federally managed fishery species

4.3.5.2.4 Protected Species

Construction activities for the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives could result in short-term minor adverse impacts to individual protected marine species that may be present in the vicinity, including the West Indian manatee, green sea turtle, hawksbill sea turtle, Kemp's Ridley sea turtle, loggerhead sea turtle, and leatherback sea turtle. Dredging, vessel traffic, and other construction activities would increase turbidity, siltation, temperature changes, vibration, and noise, leading to short-term disturbance or displacement of individuals. Sea turtles, marine mammals, and fish are highly mobile marine species, so it is likely that any individuals in the vicinity of restoration activities could leave and avoid injury from construction activities. These alternatives could result in short-term minor adverse impacts to piping plover, red knot, or whooping cranes if an individual were to fly through the area in the winter months and collide with construction equipment during inclement weather or at night.

The **Texas Breeding Shorebird and Seabird Stewardship** alternative could have short-term minor adverse effects to protected species occurring along the shoreline as a result of noise and increased vehicle and pedestrian foot traffic during implementation. Protected species that could occur within the vicinity of this alternative include piping plover, red knot, green sea turtle, Kemp's Ridley sea turtle, loggerhead sea turtle, monarch butterfly, and northern aplomado falcon.

All alternatives would be implemented in accordance with BMPs described in Section 6, Appendix A of the Final PDARP/PEIS (DWH Trustees 2016a), and BMPs, as appropriate and described in Appendix B of this document or other regulatory requirements could also be implemented to minimize collateral injury, including NMFS's *Measures for Reducing Entrapment Risk to Protected Species* (NMFS 2012), *Vessel Strike Avoidance Measures* (NMFS 2021a), *Protected Species Construction Conditions* (NMFS 2021b), and USACE *Standard Manatee Conditions for In-Water Work* (USACE 2011). The restoration or creation of new habitat and bird stewardship activities would result in long-term benefits to protected species by enhancing or protecting resources that are an important part of the food chain for coastal and marine wildlife.

4.3.5.3 SOCIOECONOMIC RESOURCES

4.3.5.3.1 Cultural Resources

An SOI-qualified archaeologist preliminarily reviewed the TASA for previously recorded cultural resources surveys and previously identified resources in the vicinity of bird alternatives. For the **Laguna Vista Rookery Island Habitat Protection** alternative, a cultural resources survey was conducted by AECOM in 2021 (Cartellone et al. 2021) and no potentially significant submerged archaeological resources were identified within the area. As the island is composed of dredge fill, it is unlikely to include significant intact cultural resources. Similarly, a cultural resources survey of the **San Antonio Bay Bird Island** alternative was conducted by BOB Hydrographics, Inc. in 2017 (Gearhart 2018) and no potentially significant submerged archaeological resources were identified. The **Jones Bay Oystercatcher Habitat Restoration** alternative and the **Gulf Cut Bird Islands Restoration** alternative footprints have not been previously surveyed for cultural resources, and no previously recorded cultural resources are mapped. Regardless of existing cultural resource surveys, formal review by DWH cultural resource liaisons would be required for all preferred bird restoration projects to determine whether cultural resources are likely to be present and could be impacted by all alternatives.

The Implementing Trustee would be responsible for ensuring compliance with the Antiquities Code of Texas, Section 106 of the NHPA, 36 CFR Section 800 and 33 CFR Section 325, and Appendix C are completed prior to any ground-disturbing activities.

Impacts to cultural resources from the birds alternatives would be site specific and would depend on the cultural resources present, their exact nature (the conditions that make the resources eligible for the NRHP, if present), the expected impacts, and the regulatory environment. Construction, ground disturbance, or other activities that could potentially alter the historic integrity of any culturally or historically important resources identified during project preparations or predevelopment surveys would be avoided during project implementation. A complete review of all alternatives to satisfy the requirements of Section 106 of the NHPA is ongoing and 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 project area. Alternatives would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

4.3.5.3.2 Socioeconomics and Environmental Justice

During construction or implementation of stewardship activities, access to areas in the vicinity of all birds alternatives could be restricted, which could cause minor short-term adverse impacts for some individuals. Short-term beneficial effects to the local and regional economies could also occur from construction-related employment to implement the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives. These jobs would likely provide some income, sales, and economic activity in the immediate area. All alternatives would also enhance wildlife habitat, resulting in long-term socioeconomic benefits associated with wildlife viewing opportunities.

The birds alternatives would occur in four counties that include low-income and/or minority populations: Cameron, Nueces, Aransas, and Refugio Counties. Analysis methodology of these communities with environmental justice concerns is described in Section 4.3.1.3.2. Due to the limited duration and magnitude of impacts, the Texas TIG does not believe that adverse impacts associated with the birds alternatives would be disproportionately born by communities with environmental justice concerns or exceed risk levels relative to the general population. Implementation of BMPs would further reduce the magnitude of these impacts. The Implementing Trustee will conduct outreach that includes strategies to reach low-income and minority populations. Additionally, the Texas TIG will engage with local officials and residents throughout the public involvement process for the RP/EA #2.

4.3.5.3.3 Tourism and Recreation Use

Construction or implementation activities associated with all birds alternatives could result in minor short-term adverse impacts to tourism and recreation use due to construction noise, equipment, and activities, which could restrict access or cause recreationists to avoid work areas during construction. Construction activities would also result in temporary changes to the aesthetics, which could have minor and short-term adverse effects on tourism and recreation use (see Section 4.3.5.3.4). Long-term improvements to wildlife habitat under all birds alternatives would result in benefits associated with wildlife viewing opportunities.

4.3.5.3.4 Aesthetics and Visual Resources

Construction activities from the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives could result in short-term adverse impacts to aesthetics and visual resources in the vicinity of Laguna Madre, Jones Bay, San Antonio Bay, and Matagorda Bay due to views of barges, excavators, and workers at restoration sites. Stewardship activities under the **Texas Breeding Shorebird and Seabird**

Stewardship alternative could also result in a minor long-term adverse impact due to views of the installation of symbolic fencing and signage. However, long-term improvements to views of natural habitat and wildlife species would benefit aesthetics and visual resources.

4.3.5.3.5 Infrastructure

The **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives would involve construction activities that could result in short-term minor interruption or damage to existing infrastructure within construction footprints. However, alternatives would be sited to avoid destroying, damaging, burying, or exposing existing subsea pipelines, cables, and other infrastructure to the extent possible in accordance with the applicable state law, RMCs and BMPs, as appropriate and disclosed in Appendix B of this document. These alternatives would provide a long-term benefit to infrastructure on the landward side of islands and reefs by preventing coastal erosion, improving shoreline integrity, and providing a buffer against potential hazards (i.e., storm surge, sea level rise, and flooding).

4.3.5.3.6 Fisheries and Aquaculture

The **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives could result in impacts to commercial fishing due to in-water activities that temporarily displace nearby fish species. Additionally, some fishing grounds could be temporarily off-limits during construction. These would be short-term minor adverse impacts. In the long term, creation of bird islands could increase available shallow water estuarine areas that provide habitat for juveniles and feeding for some species of fish and shellfish, which could provide long-term benefits to commercial fishing. Placement of in-water structures would also provide a hard surface for encrusting species (oyster and others mentioned above) and filamentous algae to attach. These habitat features would attract other invertebrates (e.g., amphipods, isopods, and copepods), which attract other fishery species (e.g., planktivorous, carnivorous, and scavengers).

4.3.5.3.7 Marine Transportation

During construction of the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives, the presence of construction vessels and platforms would result in a minor short-term adverse impact to navigation in the area. However, staging and anchoring areas would be sufficiently offset from any navigation channels, so that there would be sufficient space for recreational and larger commercial vessels to avoid construction equipment and vessels. Multiple construction activities occurring in the same area would be completed in phases or coordinated, to the extent practicable, to minimize vessel-related accidents and conflicts.

Once constructed, new bird islands and submerged structures could also result in changes to marine navigation safety and routes. However, standard USCG requirements would be implemented, such as notices to mariners, temporary lights on equipment and material barges, and/or use of signage or navigational aids on submerged structures. Required signage would not be located within any local navigation channel, either maintained or natural. New islands and structures would be added to navigation charts to avoid possible navigation impacts. Additionally, these components would be sited to avoid existing navigation channels. Therefore, adverse impacts would be long term but minor.

4.3.5.3.8 Public Health and Safety

During construction of the **Bird Islands** and **Laguna Vista Rookery Island Habitat Protection** alternatives, the operation of heavy equipment, vehicles, and/or offshore vessels could result in short-term minor adverse risks to public health and safety. If hazardous chemicals or other materials are unintentionally released into the environment, soils, groundwater, and surface waters would be adversely impacted. However, any hazardous materials used during construction would be contained and BMPs, as appropriate and described in Appendix B of this document would be implemented to protect health and safety. In the long term, implementation of these alternatives would reduce coastal shoreline erosion and improve water quality, thereby also reducing health and safety concerns.

4.3.5.4 SUMMARY

As described in detail above, the **Bird Islands** alternatives would result in the following impacts:

- Physical resources – There would be short- to long-term, minor adverse impacts to physical resources through disturbance of substrate and soils, turbidity and/or equipment leaks/discharges in the water column during island creation, air emissions, and noise generated by construction equipment and vessel traffic. Long-term beneficial effects to geology and water quality would occur due reduced wave energy and shoreline erosion.
- Biological resources –There would be long-term minor adverse impacts from conversion of existing open water and soft-bottom habitat to upland island and/or hard-bottom habitat. These alternatives could also result in short-term minor wildlife disturbance or displacement, as well as increased turbidity, siltation, entrainment of benthic species, temperature changes, increased biological oxygen demand due to the introduction of organic matter into the water column, decreased dissolved oxygen, vibration, and noise. Increased available complex habitats (shallow water estuarine areas, living shoreline and reef) that are important to lifecycles of birds, fish, shellfish and benthic communities would represent a long-term benefit.
- Socioeconomic resources –There would be short-term, minor, localized disruptions to use, navigation, infrastructure, and aesthetic changes in the vicinity of construction areas due to construction noise, unavailable open water areas, equipment, and human activities. This alternative would not cause disproportionately high and adverse impacts to communities with environmental justice concerns, and any adverse impacts to public health and safety would be minor and short term. Short-term beneficial effects to the local and regional economies could also occur from construction-related employment. Impacts to cultural resources would be site specific and would depend on the cultural resources present, their exact nature (the conditions that make the resources eligible for the NRHP, if present), expected impacts, and the regulatory environment. A complete review of all alternatives to satisfy the requirements of Section 106 of the NHPA is ongoing and would be completed prior to any activities that would restrict consideration of measures to avoid, minimize, or mitigate any adverse effects on historic properties. Over the long-term, this alternative would provide socioeconomic benefits by 1) reducing coastal infrastructure risks associated sea level rise and storm surges exist and 2) providing additional opportunities for wildlife viewing and recreational or commercial fishing.

The **Laguna Vista Rookery Island Habitat Protection** alternative would result in similar adverse and beneficial impacts to those discussed for the **Bird Islands** alternative because all alternatives propose construction activities to restore habitat. However, shoreline and upland habitats associated with the **Laguna Vista Rookery Island Habitat Protection** alternative would also experience short-term minor adverse impacts during construction of the revetment and the shoreline stability grading effort, including increased risk of non-native species introduction. However, all temporarily disturbed areas would be replanted with native vegetation.

As described in detail above, the **Texas Breeding Shorebird and Seabird Stewardship** alternative would result in the following impacts:

- Physical resources –There would be short-term minor adverse impacts to substrates or due to installation of fencing and signage, as well as from increased vehicle and pedestrian foot traffic during implementation.

- Biological resources –There would be short-term minor adverse impacts to habitat, general wildlife, and protected species occurring along the shoreline as a result of noise and increased vehicle and pedestrian foot traffic during implementation.
- Socioeconomic resources –There would be short-term adverse minor impacts to tourism and recreation use and aesthetics due to noise, equipment, and activities.

4.4 Environmental Consequences of Engineering and Design Alternatives

One E&D alternative is evaluated in the RP/EA #2:

- **Petronila Creek Constructed Wetlands Planning**

This E&D alternative is described in detail in Section 3. The proposed alternative would include a feasibility study and, if determined to be feasible, development of 30% E&D components and completion of the planning stages (including permit applications, appropriate environmental compliance reviews, and management plans) necessary to convert a 240-acre agricultural tract to constructed wetlands through which Petronila Creek would be diverted.

The purpose of E&D alternatives is to develop sufficient information to evaluate the project's merits before conducting a more detailed analysis in a subsequent restoration plan or for use in the restoration planning process. Although information gathered could inform future alternatives, the outcome of the preliminary phases does not commit the Texas TIG to future actions. If construction in a subsequent phase is later proposed for implementation with DWH NRDA funds, a NEPA analysis of the impacts from that future phase would be included in the associated restoration plan.

Project-planning actions for the **Petronila Creek Constructed Wetlands Planning** alternative fall within the scope of E&D activities evaluated in Section 6.4.14 in the Final PDARP/PEIS (DWH Trustees 2016a). No adverse impacts are anticipated, as proposed E&D activities are desktop only and would not result in vehicle emissions, fieldwork, or other ground-disturbing activities. Preliminary planning phases could, however, increase the effectiveness and efficiency of restoration efforts if the alternative is implemented at a later stage. The Texas TIG has concluded that potential impacts from the **Petronila Creek Constructed Wetlands Planning** alternative fall within those analyzed for preliminary phases of restoration in the Final PDARP/PEIS, and thus no further NEPA analysis is required at this time.

4.5 No Action Alternative

Analysis of the No Action Alternative provides "a benchmark, enabling decision-makers to compare the magnitude of environmental effects of the action alternatives." Under NEPA, "no action" has two interpretations. First, "no action" may mean "no change" from a current management direction or level of management intensity. Impacts of proposed actions would be compared to those impacts for the existing actions. Second, "no action" may mean "no project" in cases where a new project is proposed for implementation.

Under the No Action Alternative, the Texas TIG would not, at this time, select and implement the alternatives evaluated in the RP/EA #2 intended to compensate for lost natural resources or their services resulting from the DWH oil spill. The No Action Alternative would not meet the purpose and need for implementing alternatives that address lost natural resources and their services as described in Section 5.3.2 of the Final PDARP/PEIS (DWH Trustees 2016a) and Section 1.4 of this document. The No Action Alternative would not meet the DWH Trustees' goals of restoring a variety of interspersed and ecologically connected coastal habitats to maintain ecosystem diversity, with particular focus on maximizing ecological functions for the range of resources injured by the spill, such as oysters, estuarine-dependent fish species, birds, marine mammals, and nearshore benthic communities. If this plan is not implemented, none of the alternatives would be selected for implementation, and restoration benefits and services associated with these alternatives would not be achieved at this time.

4.5.1 Physical Resources

4.5.1.1 GEOLOGY AND SUBSTRATES

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative would not directly disturb geology, soils, or substrates because it would not involve any activities (construction, structure placement, etc.) that could result in effects; however, ongoing coastal erosion would likely continue unabated, resulting in long-term minor adverse impacts. The No Action Alternative would not result in any beneficial effects to geology, soils, or substrates that could occur from implementation of some of the alternatives; these beneficial effects include features that would prevent or reduce existing erosion conditions (e.g., breakwater, ridge and marsh restoration features that help reduce coastal erosion).

4.5.1.2 HYDROLOGY AND WATER QUALITY

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative would not result in direct adverse effects to hydrology or water quality because it would not involve any activities that could affect these resources. However, ongoing water quality effects from coastal erosion would likely continue unabated, resulting in long-term minor adverse impacts. The No Action Alternative would not result in any beneficial effects to hydrology and water quality that could occur as a result of implementation of the alternatives. The alternatives are intended to reduce erosion and sedimentation from entering receiving waterbodies and to improve overall hydrologic cycling in the nearshore environment, which would benefit water quality. Additionally, infrastructure features in the alternatives would result in reducing long-term erosion and sedimentation of receiving waterbodies (e.g., placement of breakwaters to reduce erosion in coastal areas). These benefits would not be realized under the No Action Alternative.

4.5.1.3 AIR QUALITY

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative would have no effect on air quality or GHGs because no activities that have potential emissions would occur.

4.5.1.4 NOISE

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, there would be no noise effects as a result of the No Action Alternative because no noise-producing activities would be proposed.

4.5.2 Biological Resources

4.5.2.1 HABITATS

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative would not result in direct effects to terrestrial, coastal, nearshore, or marine habitats because no restoration activities would occur. Alternatives considered under this document could benefit habitats by reducing erosion and land loss in coastal areas and increasing or protecting high-quality habitats. In the absence of the implementation of the alternatives, there would not be any long-term enhancement or increase in habitats that were injured by the spill. Under the No Action Alternative, potential benefits to these habitats would not occur.

4.5.2.2 WILDLIFE

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative would not result in direct effects to terrestrial wildlife or birds because no activities would occur. Some alternatives could have indirect benefits to wildlife and birds, particularly those alternatives that result in reducing erosion and land loss in coastal areas that provide habitat for many species. Habitat creation or acquisition proposed by some alternatives would benefit wildlife and migratory birds by improving or preserving areas important to reproduction, feeding and resting. In the absence of the implementation of the alternatives, there would not be any long-term enhancement or increase in species injured by the spill. Under the No Action Alternative, potential benefits to wildlife and migratory birds would not occur.

4.5.2.3 MARINE AND ESTUARINE RESOURCES

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative would not result in direct effects to marine and estuarine fauna because no activities would occur. Some alternatives could have indirect benefits to these species, particularly alternatives that result in reducing erosion and sedimentation of waterbodies that provide habitat for coastal, nearshore, marine, and estuarine species. Habitat creation or land acquisition proposed by some alternatives would preserve and/or improve areas that could be presently used by marine and estuarine fauna for feeding, breeding, or resting. In the absence of the implementation of the alternatives, there would not be long-term improvement in marine and estuarine resources injured by the spill. Under the No Action Alternative, potential benefits to these coastal, nearshore, marine, and estuarine species would not occur.

4.5.2.4 PROTECTED SPECIES

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative would not result in direct effects to protected aquatic or terrestrial species because no activities would occur. Some alternatives could have indirect benefits to protected species by improving water quality. Increasing available habitat upon which some protected aquatic species (such as Gulf sturgeon and Kemp’s Ridley sea turtle) and some terrestrial species (such as piping plover and red knot) rely on for foraging, spawning, and resting would provide a direct benefit. Under the No Action Alternative, potential short- to long-term benefits to these protected aquatic species would not occur.

4.5.3 Socioeconomic Resources

4.5.3.1 CULTURAL RESOURCES

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, there would be no effect to cultural resources for most alternatives because no activities which could affect cultural resources are proposed. However, if the land acquisition projects did not occur, short-and long-term major adverse impacts could be caused by future development of the sites and added protection of any existing cultural resources would not be realized.

4.5.3.2 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative would have no effect on socioeconomics or communities with environmental justice concerns. Some alternatives could result in small benefits to the local economy as a result of temporary construction jobs and increased tourism associated with wildlife viewing and recreation. Under the No Action Alternative, these economic benefits would not be realized.

4.5.3.3 TOURISM AND RECREATIONAL USE

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative would have no effect on tourism and recreational use, including fishing and hunting. Some of the alternatives could result in improved recreational access and use. Under the No Action Alternative, these recreational use benefits would not be realized.

4.5.3.4 AESTHETICS AND VISUAL RESOURCES

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, there would be no effect to aesthetics and visual resources as a result of the No Action Alternative because no activities which could affect existing aesthetics are proposed.

4.5.3.5 INFRASTRUCTURE

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur and there would be no impacts to infrastructure as a result of the proposed alternatives. However, the No Action Alternative could result in long-term minor adverse impacts to infrastructure as a result of ongoing and uncontrolled coastal erosion and land loss. Many of the alternatives include activities to address coastal land loss and erosion that could affect infrastructure in the future. Under the No Action Alternative, potential benefits to infrastructure from alternatives that would provide protection to coastal areas would not occur, and these potential benefits would not be realized.

4.5.3.6 FISHERIES AND AQUACULTURE

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the no direct impacts to fisheries and aquaculture would occur because no activities would occur. Benefits from alternatives, including placement of structures such as breakwaters and improved aquatic habitat, could benefit fisheries. Under the No Action Alternative, these benefits would not be realized.

4.5.3.7 MARINE TRANSPORTATION

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, there would be no effect to marine transportation as a result of the No Action Alternative because no activities that could affect vessel traffic and routes are proposed.

4.5.3.8 LAND AND MARINE MANAGEMENT

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, there would be no effect to land and marine management as a result of the No Action Alternative because no activities that could affect land use consistency are proposed. Many of the alternatives include activities to address coastal land loss and erosion that could affect land mand marine management in the future. In the absence of the implementation of the alternatives, these benefits would not be realized.

4.5.3.9 PUBLIC HEALTH AND SAFETY

Under the No Action Alternative, none of the activities proposed in the RP/EA #2 would occur. Therefore, the No Action Alternative could result in long-term minor adverse impacts to public health and safety because of the ongoing coastal erosion and land loss. The alternatives could provide benefits to coastal populations and infrastructure through improved shoreline protection, thereby improving coastal resiliency to the local areas where alternatives would be implemented. Under the No Action Alternative, these potential benefits to public health and safety would not be realized.

4.6 Reasonably Foreseeable Environmental Trends and Planned Actions Impacts

CEQ regulations require the assessment of reasonably foreseeable environmental trends and planned actions impact (also known as a cumulative impacts analysis) in the decision-making process for federal projects, plans, and programs. This analysis was conducted consistent with Section 6.6.2 of the Final PDARP/PEIS, which followed a multistep process: 1) identify resources affected, 2) establish the boundaries of analysis, 3) identify a cumulative action scenario, and 4) conduct a cumulative impacts analysis (DWH Trustees 2016a).

Resources identified for analysis are described in Section 4.3. Per 40 CFR Section 1508.1(aa), “reasonably foreseeable” trends and planned actions must be sufficiently likely to occur such that a person of ordinary prudence would take it into account in reaching a decision. For the purposes of this analysis, actions were included as part of the Reasonably Foreseeable Project List (Appendix C) if E&D, permitting, or funding has been authorized; projects that are only conceptual in nature were not evaluated.

The temporal and spatial scale of analysis was limited to the implementation phase and footprint, since the cumulative impacts analysis in the Final PDARP/PEIS provides analysis on a regional, ecosystem scale. Reasonably foreseeable future actions relevant to restoration actions that make up the impact scenario are provided in Appendix C. Past activities that have contributed to the current condition of resources are described and analyzed in Chapter 6 of the Final PDARP/PEIS and are not repeated in this analysis. Present activities are also considered to be part of the baseline described in Section 4.2 and are not included in the scenario (DWH Trustees 2016a).

The following analysis discloses RP/EA #2 alternative impacts when combined with other reasonably foreseeable environmental trends and planned actions (see Appendix C). Cumulative impact findings from Section 6.6.5 of the Final PDARP/PEIS analysis are also incorporated by reference (DWH Trustees 2016a) and summarized below. Future activities considered in the Final PDARP/PEIS include implementation activities associated with 1) DWH oil spill–related restoration projects, 2) Other Resource Stewardship Activities, 3) Energy Activities, 4) Dredging and Marine Mineral Mining, 5) Coastal Development and Land Use, 6) Fisheries and Aquaculture, 7) Marine Transportation, 8) Military Operations, and 9) Recreation and Tourism. The actions presented in Appendix C and considered below include projects from TX TIG RP/EA #1 (Texas TIG 2017), the Texas Coastal Resiliency Master Plan (TGLO 2019), and the Coastal Texas Protection and Ecosystem Restoration Study (USACE and TGLO 2021).

4.6.1 Wetlands, Coastal, and Nearshore Habitats

Relevant reasonably foreseeable environmental trends and planned actions (see Appendix C) could include 23 habitat restoration projects and six acquisition projects (e.g., Follets Island Habitat Acquisition, Pierce Marsh Wetland Restoration).

4.6.1.1 PHYSICAL RESOURCES

Future habitat restoration actions could require excavation or dredging, equipment operation, and other construction actions that generate short-term minor adverse impacts on physical resources along the Texas coast. Adverse impacts could include water quality degradation, substrate disturbances or increased erosion, and increased noise and air emissions. Long-term benefits associated with DWH oil spill–related restoration projects and Other Resource Stewardship Activities could include restored hydrology, reducing non-point source nutrients; removal of marine debris; and improved coastal ecosystem function. These long-term benefits would far outweigh short-term adverse impacts associated with these projects.

Acquisition alternatives analyzed in this document would not adversely affect physical resources since no ground disturbance or other impact-producing actions would occur. However, the Bird Island Cove Habitat Restoration - Construction alternative and the Bahia Grande Channel F Wetland Restoration alternative require construction, would contribute an additional short- to long-term minor adverse increase in sedimentation, alteration of substrate and soils, turbidity, air emissions, and noise to the affected environment.

BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid and minimize potential physical resources effects. Additionally, wetlands, coastal, and nearshore habitats alternatives would have a long-term benefit of reducing erosion and improving water quality via 1) land preservation, or 2) restoration of natural movement of water, sediments, energy, and nutrients.

Therefore, when the adverse effects on physical resources from wetlands, coastal, and nearshore habitats alternatives are considered in combination with the planned actions such as those in Appendix C, there would be short- to long-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to physical resources.

4.6.1.2 BIOLOGICAL RESOURCES

Relevant reasonably foreseeable environmental trends and planned actions could require excavation or dredging, grading, vessel traffic, equipment operation, and other construction actions that could generate short- to long-term minor to moderate adverse impacts to biological resources. Adverse impacts could include potential introduction or opportunity for establishment of invasive species; habitat conversion, fragmentation, or degradation/loss; or changes in prey availability. Long-term benefits associated with DWH oil spill–related restoration projects, Other Resource Stewardship Activities, and some Recreation and Tourism projects could improve the health, stability, and resiliency of habitats by re-establishing native plant communities, stabilizing substrates, supporting sediment deposition, strengthening shorelines, and reducing erosion, among other habitat improvements. These long-term benefits would far outweigh short-term adverse impacts associated with these projects.

Acquisition alternatives would not adversely affect biological resources since no ground disturbance or other impact-producing actions would occur. However, the Bird Island Cove Habitat Restoration - Construction alternative and the Bahia Grande Channel F Hydrologic Restoration alternative require construction, which would contribute additional short-term minor to moderate adverse water quality and temperature changes, disturbance of feeding or spawning, burial of benthic organisms, habitat removal, and wildlife disruption or displacement to the affected environment.

BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid and minimize potential biological resource effects. Additionally, wetlands, coastal, and nearshore habitats alternatives would have a long-term benefit of creating or improving available habitat, increasing shoreline stabilization and improving water quality and prey availability via 1) land preservation, or 2) restoration of natural movement of water, sediments, energy, and nutrients.

Therefore, when the adverse effects on biological resources from wetlands, coastal, and nearshore habitats alternatives are considered in combination with the planned actions in Appendix C, there would be short- to long-term minor to moderate adverse impacts in localized areas. There could also be long-term beneficial effects to biological resources.

4.6.1.3 SOCIOECONOMIC RESOURCES

Relevant reasonably foreseeable environmental trends and planned actions could require seafloor disturbance, temporary access restrictions, equipment operation, and other construction actions that could generate short- to long-term minor to moderate adverse impacts to socioeconomic resources. Adverse impacts could include changes such as the use of alternative gear, repose, quota shifting, or restrictions on areas available for activities and associated visitation and spending. Short-term benefits are also possible due to construction activities that generate new jobs and revenue. These benefits would depend on regional economic conditions, the types of activities occurring, their economic impacts, and their location with respect to regional economies. Long-term benefits associated with DWH oil spill–related restoration projects, Other Resource Stewardship Activities, and some Recreation and Tourism projects could include increased opportunities for wildlife viewing, fishing, or other recreation activities., as well as reduced risk of potential hazards, such as storm surges, and improving shoreline integrity. These long-term benefits would far outweigh short-term adverse impacts associated with these projects.

Acquisition alternatives would contribute short-term minor to moderate adverse economic changes due to changes in development activities, spending, and taxes. The Bird Island Cove Habitat Restoration - Construction alternative and the Bahia Grande Channel F Hydrologic Restoration alternative would also require construction, which would contribute additional short- to long-term minor to moderate adverse disturbance to cultural resources, fisheries, marine transportation, aesthetics and visual resources, and tourism and recreation use due to construction noise, equipment, vessel traffic, and views of human activities. Operation of heavy equipment, vessel traffic, and use of hazardous chemicals or other materials could also add short-term minor adverse impacts to public health and safety. Alternatives with a construction component would also provide a short-term beneficial impact through construction-related employment.

Adverse impacts to cultural resources are not expected to occur from the projects proposed in the RP/EA #2. Impacts to cultural resources would be avoided, and if any instance occurred where that would not be practicable, impacts would be minimized or mitigated in accordance with the NHPA Section 106 consultation process. Habitat alternatives evaluated in this document would have a long-term benefit of preserving or improving habitats, which could lead to improved aesthetics, tourism and recreation opportunities, increasing shoreline stabilization and water quality, and improving fishing opportunities. Therefore, when the adverse effects on socioeconomic resources from wetlands, coastal, and nearshore habitats alternatives are considered in combination with the planned actions, there would be short- to long-term minor to moderate adverse impacts in localized areas. There could also be long-term beneficial effects to socioeconomic resources.

4.6.2 Nutrient Reduction

No specific planned actions were identified in the vicinity of Nutrient Reduction alternatives (see Appendix C). However, ongoing agricultural activities would generate short-term minor adverse noise and air emissions, as well as potential for soil erosion and sedimentation. Agricultural activities could also result in habitat conversation or loss, as well as provide jobs and revenue.

4.6.2.1 PHYSICAL RESOURCES

Implementation of structural and non-structural conservation practices and a meandering flow way with a vegetated buffer for the Petronila Creek Watershed Nutrient Reduction Initiative alternative and the Petronila Creek Crooked Ditch alternative, respectively, would contribute additional short-term minor adverse noise, air emissions, and erosion to ongoing agricultural activities occurring on the landscape. However, conservation practices and vegetative buffers would be designed to reduce erosion and soil disturbance.

Therefore, when the adverse effects on physical resources from nutrient reduction alternatives are considered in combination with reasonably foreseeable trends, there would be short-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to physical resources.

4.6.2.2 BIOLOGICAL RESOURCES

Implementation of structural and non-structural conservation practices and a meandering flow way with a vegetated buffer for the Petronila Creek Watershed Nutrient Reduction Initiative alternative and the Petronila Creek Crooked Ditch alternative, respectively, would contribute additional short-term minor adverse habitat loss, invasive species introduction, and human noise and disturbance to ongoing agricultural activities occurring on the landscape. However, conservation practices and vegetative buffers would be designed to improve habitat and water quality conditions.

Therefore, when the adverse effects on biological resources from nutrient reduction alternatives are considered in combination with reasonably foreseeable trends, there would be short-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to biological resources.

4.6.2.3 SOCIOECONOMIC RESOURCES

Implementation of structural and non-structural conservation practices and a meandering flow-way with a vegetated buffer for the Petronila Creek Watershed Nutrient Reduction Initiative alternative and the Petronila Creek Crooked Ditch alternative, respectively, could contribute additional short-term minor to moderate adverse impacts to business/agricultural operations, and infrastructure that coincide with ground-disturbing activities. Adverse impacts to cultural resources are not expected to occur. Impacts to cultural resources would be avoided, and if any instance occurred where that would not be practicable, impacts would be minimized or mitigated in accordance with the NHPA Section 106 consultation process. Conservation practices and vegetative buffers would also be designed to improve habitat and water quality conditions.

Therefore, when the adverse effects on socioeconomic resources from nutrient reduction alternatives are considered in combination with reasonably foreseeable trends, there would be short-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to socioeconomic resources.

4.6.3 Oysters

Relevant reasonably foreseeable environmental trends and planned actions (see Appendix C) could include nine E&D and/or construction projects providing oyster reef creation or restoration (e.g., Oyster Restoration Engineering Project; Improving Resilience for Oysters by Linking Brood Reefs and Sink Reefs (Large-scale), Component 1: East Galveston Bay, Texas; Portal ID # 110, https://www.gulfspill restoration.noaa.gov/project?id=110). Two bird restoration projects and 12 habitat restoration projects that implement offshore structures (breakwaters, reefs) that could benefit oysters are also included.

4.6.3.1 PHYSICAL RESOURCES

Implementation of planned actions such as those identified in Appendix C could require excavation or dredging, placement of cultch, equipment operation, and other construction actions that could generate short- to long-term minor adverse impacts to physical resources. Additional discussion of relevant reasonably foreseeable environmental trends and planned actions potential impacts is provided in Section 4.6.1.1. Oyster reef construction activities proposed under the oyster alternatives in this document would contribute an additional short- to long-term minor adverse increase in sedimentation, turbidity, air emissions, and noise to the affected environment. However, proposed reef restoration actions would have a long-term benefit of providing additional substrate suitable for oyster recruitment, increasing shoreline stabilization, and improving water quality due to increased filter feeding.

Therefore, when the adverse effects on physical resources from oysters alternatives are considered in combination with the planned actions, there would be short- to long-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to physical resources.

4.6.3.2 BIOLOGICAL RESOURCES

Implementation of planned actions identified in Appendix C could require excavation or dredging, placement of cultch, equipment operation, vessel traffic, and other construction actions that would generate short- to long-term minor adverse impacts to biological resources. Additional discussion of relevant reasonably foreseeable environmental trends and planned actions potential impacts is provided in Section 4.6.1.2.

Oyster reef construction activities proposed under the oyster alternatives would contribute additional short-term minor adverse water quality and temperature changes, disturbance of feeding or spawning, burial of benthic organisms, and wildlife disruption or displacement to the affected environment. However, reef restoration actions would have a long-term benefit of providing new and improved habitat for aquatic organisms, increasing shoreline stabilization, and improving prey availability.

Therefore, when the adverse effects on biological resources from oysters alternatives are considered in combination with the planned actions, there would be short- to long-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to biological resources.

4.6.3.3 SOCIOECONOMIC RESOURCES

Implementation of planned actions could require seafloor disturbance, temporary access restrictions, equipment operation, and other construction actions that would generate short- to long-term minor to moderate adverse impacts to socioeconomic resources. Additional discussion of relevant reasonably foreseeable environmental trends and planned actions potential impacts is provided in Section 4.6.1.3.

Oyster reef construction activities proposed under the oyster alternatives in this document could contribute additional short- to long-term minor to moderate adverse impacts to fisheries, marine transportation, aesthetics and visual resources, and tourism and recreation use due to construction noise, equipment, vessel traffic and views of human activities. Operation of heavy equipment, vessel traffic, and use of hazardous chemicals or other materials could also add short-term minor adverse impacts to public health and safety. Adverse impacts to cultural resources are not expected to occur. Impacts to cultural resources would be avoided, and if any instance occurred where that would not be practicable, impacts would be minimized or mitigated in accordance with the NHPA Section 106 consultation process.

These alternatives would also provide a short-term beneficial impact through construction-related employment. Reef restoration actions would provide a long-term benefit via new and improved habitat that could lead to improved aesthetics and tourism and recreation-related economic opportunities.

Therefore, when the adverse effects on socioeconomic resources from oysters alternatives are considered in combination with the planned actions, there would be short- to long-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to socioeconomic resources.

4.6.4 Sea Turtles

Relevant reasonably foreseeable environmental trends and planned actions (see Appendix C) could include five sea turtle restoration projects (e.g., Reducing Marine Debris Impacts on Birds and Sea Turtles and Regionwide Enhancements to the Sea Turtle Stranding and Salvage Network and Enhanced Rehabilitation; Portal ID # 171; https://www.gulfspillrestoration.noaa.gov/project?id=171).

4.6.4.1 PHYSICAL RESOURCES

Implementation of planned actions could require varied activities such as dredging/gear removal, surveys, sign installation, or heavy equipment use that could generate short-term minor adverse impacts to physical resources. Additional discussion of relevant reasonably foreseeable environmental trends and planned actions potential impacts is provided in Section 4.6.1.1.

Implementation of the rehabilitation facility, enhanced patrols and nest protection actions analyzed under the sea turtle alternatives in this document would contribute additional short- to long-term minor adverse impacts to the affected environment. Most impacts would be associated with construction of the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative, which could increase stormwater runoff, sedimentation, and transport of stormwater pollutants, as well as generate additional air emissions and noise.

BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid and minimize potential physical resource effects. Therefore, when the adverse effects on physical resources from sea turtle alternatives are considered in combination with the planned actions, there would be short- to long-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to physical resources.

4.6.4.2 BIOLOGICAL RESOURCES

Implementation of planned actions could require varied activities such as dredging/gear removal, surveys, sign installation, vessel traffic, or heavy equipment use which could generate short- to long-term minor adverse impacts to biological resources. Additional discussion of relevant reasonably foreseeable environmental trends and planned actions potential impacts is provided in Section 4.6.1.2.

Implementation of the rehabilitation facility, enhanced patrols under the sea turtle lancha mitigation program, and nest protection actions analyzed under the sea turtle alternatives would contribute additional short- to long-term minor adverse impacts to the affected environment. Most impacts would be associated with construction of the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative, which would result in habitat removal and wildlife disruption or displacement.

BMPs, as appropriate and described in Appendix B of this document, would be implemented to avoid and minimize potential biological resource effects. Additionally, restoration actions would have a long-term benefit of reducing sea turtle injuries or mortality. Therefore, when the adverse effects on biological resources from sea turtle alternatives are considered in combination with the planned actions, there would be short- to long-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to biological resources.

4.6.4.3 SOCIOECONOMIC RESOURCES

Implementation of planned actions could require varied activities such as dredging/gear removal, surveys, sign installation, vessel traffic, or heavy equipment use which could generate short-term minor to moderate adverse impacts to socioeconomic resources. Additional discussion of relevant reasonably foreseeable environmental trends and planned actions potential impacts is provided in Section 4.6.1.3.

Implementation of the rehabilitation facility, enhanced patrols, and nest protection actions analyzed under the sea turtle alternatives would contribute additional short- to long-term minor to moderate adverse socioeconomic impacts to the affected environment. Most impacts would be associated with construction of the **Upper Texas Coast Sea Turtle Rehabilitation Facility** alternative, which could result in exposure to construction noise, equipment, and views of human activities. This alternative would also provide a short-term beneficial impact through construction-related employment. Implementation of the **Kemp's Ridley Sea Turtle Nest Protection** alternative and the **Lancha Sea Turtle Mitigation Plan** alternative could also result in localized reductions in recreational access.

Adverse impacts to cultural resources are not expected to occur. Impacts to cultural resources would be avoided, and if any instance occurred where that would not be practicable, impacts would be minimized or mitigated in accordance with the NHPA Section 106 consultation process.

BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid and minimize potential socioeconomic resources effects. Additionally, restoration actions would have a long-term benefit of 1) reducing conflict among legal and illegal fishers, and 2) enhancing wildlife viewing opportunities.

Therefore, when the adverse effects on socioeconomic resources from sea turtle alternatives are considered in combination with the planned actions, there would be short- to long-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to socioeconomic resources.

4.6.5 Birds

Relevant reasonably foreseeable environmental trends and planned actions (see Appendix C) could include three bird restoration projects (e.g., Conservation and Enhancement of Nesting and Foraging Habitat for Birds, Component 3: San Antonio Bay Bird Island, Texas; Texas Rookery Islands; Portal ID #173; https://www.gulfspillrestoration.noaa.gov/project?id=173). Nine oyster restoration projects, 23 habitat restoration projects, and six acquisition projects are also included, which could benefit birds.

4.6.5.1 PHYSICAL RESOURCES

Implementation of planned construction actions could require excavation or dredging, placement of fill, equipment operation, and other construction actions that could generate short- to long-term minor adverse impacts to physical resources. Additional discussion of relevant reasonably foreseeable environmental trends and planned actions potential impacts is provided in Section 4.6.1.1.

Implementation activities associated with bird islands and other habitat restoration proposed under the birds alternatives in this document would contribute additional short- to long-term minor adverse increase in sedimentation, alteration of substrate and soils, turbidity, air emissions, and noise to the affected environment. However, bird restoration actions would have a long-term benefit of increasing habitat, shoreline stabilization, and improving water quality.

Therefore, when the adverse effects on physical resources from birds alternatives are considered in combination with the planned actions, there would be short- to long-term minor adverse impacts in localized areas. There could also be long-term beneficial effects to physical resources.

4.6.5.2 BIOLOGICAL RESOURCES

Implementation of planned actions could require excavation or dredging, grading, placement of fill, vessel traffic, equipment operation, and other construction actions that could generate short- to long-term minor to moderate adverse impacts to biological resources. Additional discussion of relevant reasonably foreseeable environmental trends and planned actions potential impacts is provided in Section 4.6.1.2.

Implementation activities associated with bird islands and other habitat restoration proposed under the birds alternatives would contribute additional short- to long-term minor to moderate adverse water quality and temperature changes, disturbance of feeding or spawning, burial of benthic organisms, habitat removal, and wildlife disruption or displacement to the affected environment.

BMPs, as appropriate and described in Appendix B of this document would be implemented to avoid and minimize potential biological resource effects. Additionally, bird restoration actions would have a long-term benefit of creating or improving available habitat, increasing shoreline stabilization, and improving water quality and prey availability.

Therefore, when the adverse effects on biological resources from birds alternatives are considered in combination with the planned actions, there would be short- to long-term minor to moderate adverse impacts in localized areas. There could also be long-term beneficial effects to biological resources.

4.6.5.3 SOCIOECONOMIC RESOURCES

Implementation of planned actions could require excavation or dredging, grading, placement of fill, vessel traffic, equipment operation, and other construction actions that could generate short- to long-term minor to moderate adverse impacts to socioeconomic resources. Additional discussion of relevant reasonably foreseeable environmental trends and planned actions potential impacts is provided in Section 4.6.1.3.

Implementation activities associated with bird islands and other habitat restoration proposed under the birds alternatives could contribute additional short- to long-term minor to moderate adverse disturbance to fisheries, marine transportation, aesthetics and visual resources, and tourism and recreation use due to construction noise, equipment, vessel traffic and views of human activities. Operation of heavy equipment, vessel traffic, and use of hazardous chemicals or other materials could also add short-term minor adverse impacts to public health and safety. Alternatives with a construction component would also provide a short-term beneficial impact through construction-related employment.

Adverse impacts to cultural resources are not expected to occur. Impacts to cultural resources would be avoided, and if any instance occurred where that would not be practicable, impacts would be minimized or mitigated in accordance with the NHPA Section 106 consultation process. Additionally, bird restoration actions would have a long-term benefit providing new and improved habitat that could lead to improved aesthetics, tourism and recreation opportunities, increasing shoreline stabilization and water quality, and improving fishing opportunities. Therefore, when the adverse effects on socioeconomic resources from birds alternatives are considered in combination with the planned actions, there would be short- to long-term minor to moderate adverse impacts in localized areas. There could also be long-term beneficial effects to socioeconomic resources.

4.6.6 No Action Alternative

Under the No Action Alternative, there would be no direct adverse effects to physical resources (see Section 4.5.1), biological resources (see Section 4.5.2), or socioeconomic resources (see Section 4.5.3). However, impacts described for reasonably foreseeable environmental trends and planned actions would be expected to continue.

4.7 Comparison of Alternatives

The environmental analysis determined that there would be primarily minor, but also some moderate short- and long-term adverse impacts as well as environmental benefits from implementation of the RP/EA #2 alternatives. The No Action Alternative is also anticipated to result in long-term minor adverse impacts. Adverse impacts would be minimized by following mitigation measures, BMPs, and other guidance developed during the permitting process, environmental reviews, consultation process, and other relevant regulatory requirements. The Texas TIG would also consider BMPs referenced in Appendix B of this document and Appendix 6.A of the Final PDARP/PEIS (DWH Trustees 2016a).

A summary of impacts for each restoration alternative (excluding the E&D only alternative) and the No Action alternative is provided in Table 4-8. Per Section 4.4, no adverse impacts are anticipated for the E&D only alternative, as proposed E&D activities would not result in vehicle emissions, fieldwork, or other ground-disturbing activities.

Table 4-7. Comparison of Alternative Impacts

Restoration Alternative	Geology and Substrates	Hydrology and Water Quality	Air Quality	Noise	Habitats	Wildlife Species	Marine and Estuarine Resources	Protected Species	Cultural Resources	Socioeconomics and Environmental Justice	Tourism and Recreational Use	Aesthetics and Visual Resources	Infrastructure	Fisheries and Aquaculture	Marine Transportation	Land and Marine Management	Public Health and Safety
No Action	l	l	NE	NE	l	l	l	s,l	**S,L**	l	l	NE	l	NE	NE	NE	l
Wetlands, Coastal, and Nearshore Habitats																	
Bird Island Cove Habitat Restoration – Construction	S,L,+	s,+	s	s	s,l,+	s,+	S,L,+	s,+	NE	s,+	s	s,+	s,+	s,+	s,l,+	NE	s,+
Bahia Grande Channel F Hydrologic Restoration	S,L,+	s,+	s	s	s,+	s,+	NE	s,+	NE	s,+	s	s,+	s,+	+	NE	NE	s,+
Follets Island Habitat Acquisition Phase 2	NE	NE	NE	NE	+	+	+	+	+	s,l,+	+	+	+	+	NE	s,+	+
Galveston Island Habitat Acquisition	NE	NE	NE	NE	+	+	+	+	+	s,l,+	NE	+	+	+	NE	s,+	+
Matagorda Peninsula Habitat Acquisition	NE	NE	NE	NE	+	+	+	+	+	s,l,+	+	+	+	+	NE	s,+	+
Nutrient Reduction (Nonpoint Source)																	
Petronila Creek Watershed Nutrient Reduction Initiative	s,+	s,+	s	NE	s,+	NE	NE	s,+	NE	s,+	NE	NE	NE	NE	NE	NE	s,+
Petronila Creek Crooked Ditch Restoration	s,+	s,+	s	NE	s,+	NE	NE	s,+	NE	s,+	NE	NE	NE	NE	NE	NE	s,+

+ = Beneficial effect
NE = No effect
s = Short-term minor adverse effect
S = Short-term moderate adverse effect
S = Short-term major adverse effect
l = Long-term minor adverse effect
L = Long-term moderate adverse effect
L = Long-term major adverse effect

Restoration Alternative	**Geology and Substrates**	**Hydrology and Water Quality**	**Air Quality**	**Noise**	**Habitats**	**Wildlife Species**	**Marine and Estuarine Resources**	**Protected Species**	**Cultural Resources**	**Socioeconomics and Environmental Justice**	**Tourism and Recreational Use**	**Aesthetics and Visual Resources**	**Infrastructure**	**Fisheries and Aquaculture**	**Marine Transportation**	**Land and Marine Management**	**Public Health and Safety**
Oysters																	
Landscape Scale Oyster Restoration in Galveston Bay	s,+	s,+	s	s	s,l,+	s,+	s,l,+	s,+	NE	s,+	s,+	s,+	s,+	s,+	s,l,+	NE	s,+
St. Charles Bay Oyster Reef Restoration	s,+	s,+	s	s	s,l,+	s,+	s,l,+	s,+	NE	s,+	s,+	s,+	s,+	s,+	s,l,+	NE	s,+
Sea Turtles																	
Upper Texas Coast Sea Turtle Rehabilitation Facility	s,l	s	s	s	l	s,l	NE	s	NE	+	NE	s	NE	NE	NE	NE	s
Lancha Sea Turtle Mitigation Plan	l	s	s	s	s,l	l	s,+	s,+	NE	+	s,+	NE	NE	+	NE	NE	NE
Kemp's Ridley Sea Turtle Nest Protection	s	NE	NE	NE	s	NE	NE	s	NE	+	s,+	NE	NE	NE	NE	NE	NE
Birds																	
Laguna Vista Rookery Island Habitat Protection	s,l,+	s,+	s	s	s,l,+	s,+	s,l,+	s,+	NE	s,+	s,+	s,+	s,+	s,+	s,l,+	NE	s,+
Jones Bay Oystercatcher Habitat Restoration	s,l,+	s,+	s	s	s,l,+	s,+	s,l,+	s,+	NE	s,+	s,+	s,+	s,+	s,+	s,l,+	NE	s,+
San Antonio Bay Bird Island	s,l,+	s,+	s	s	s,l,+	s,+	s,l,+	s,+	NE	s,+	s,+	s,+	s,+	s,+	s,l,+	NE	s,+
Texas Breeding Shorebird and Seabird Stewardship	s,+	s	NE	NE	s	s,+	s	s,+	NE	+	s,+	s,+	s,+	NE	NE	NE	NE
Gulf Cut Bird Islands Restoration	s,l,+	s,+	s	s	s,l,+	s,+	s,l,+	s,+	NE	s,+	s,+	s,+	s,+	s,+	s,l,+	NE	s,+

+ = Beneficial effect
NE = No effect
s = Short-term minor adverse effect
S = Short-term moderate adverse effect
S = Short-term major adverse effect
l = Long-term minor adverse effect
L = Long-term moderate adverse effect
L = Long-term major adverse effect

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CHAPTER 5 COMPLIANCE WITH OTHER LAWS AND REGULATIONS

This section provides a summary of RP/EA #2 compliance with other laws and regulatory requirements. The TX TIG is currently coordinating environmental reviews with the relevant agencies. The TX TIG would ensure that all alternatives are implemented in accordance with all applicable federal, state, and local laws and regulations.

Section 9.4.6 of the Trustee Council SOP provides procedures designed to help ensure the Trustees comply with federal environmental compliance responsibilities. The Implementing Trustee(s) for each alternative will ensure that the status of environmental compliance is tracked through the Trustee Council's website. The Implementing Trustee(s) will keep a record of compliance documents (e.g., ESA biological opinions, USACE permits), and will submit them to the DWH Administrative Record. Implementing Trustees are required to implement alternative-specific mitigation measures (including BMPs) identified in this document and in completed consultations/permits. They are required to ensure that implementation does not have unanticipated effects to listed species and habitats.

Wherever existing consultations or permits are present, they will be reviewed to determine if the consultations/permits are still valid or if re-initiation of any consultations or permits are necessary. Implementing Trustees are required to implement alternative-specific mitigation measures (e.g., BMPs) identified in this RP/EA #2 and in completed consultations/permits. The Implementing Trustees would provide oversight and conduct due diligence with regard to ensuring no unanticipated effects to listed species and habitats occur, including ensuring that BMPs are implemented and continue to function as intended. Pursuant to the Coastal Zone Management Act, federal activities must be consistent to the maximum extent practicable with the federally approved coastal management programs for states where the activities would affect a coastal use or resource. Federal Trustees are submitting consistency determinations for state review coincident with public review of this document.

Projects involving in-water work would require a Clean Water Act (CWA) Section 404 permit and/or Rivers and Harbors Act (RHA) Section 10 permit. Any work in waters of the U.S., including wetlands, associated with preferred alternatives would be coordinated with the USACE pursuant to Section 404 of the CWA and Section 10 of the RHA. Coordination with USACE and final authorization pursuant to CWA and RHA would be completed prior to final design and construction.

Table 5-1 shows each preferred alternative's status regarding applicable environmental compliance requirements at the time of the draft RP/EA #2's publication. This status will be updated in the final RP/EA #2 and after completion of the final RP/EA #2, status of environmental compliance requirements can be found here: https://www.gulfspillrestoration.noaa.gov/environmental-compliance?field_tig_tid%5B%5D=3.

Table 5-1. Current Status of Federal Regulatory Compliance Reviews and Approvals of Preferred Alternatives in the RP/EA #2

Restoration Alternative	Coastal Zone Management Act (CZMA)	Endangered Species Act – Section 7 (NMFS)	Endangered Species Act – Section 7 (USFWS)	Magnuson-Stevens Act (EFH; NMFS)	Marine Mammal Protection Act (MMPA (NMFS)	Marine Mammal Protection Act (MMPA (USFWS)	National Historic Preservation Act (NHPA)	Rivers and Harbors Act/Clean Water Act (USACE permit)	Coastal Barrier Resources Act (USFWS)	Bald and Golden Eagle Protection Act (BGEPA)	Migratory Bird Treaty Act (MBTA)
Petronila Creek Constructed Wetlands Planning	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	IP	IP
Petronila Creek Watershed Nutrient Reduction Initiative	N/A	Ph	N/A	Ph	N/A	N/A	Ph	Ph	N/A	IP	IP
Landscape Scale Oyster Restoration in Galveston Bay	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP
Upper Texas Coast Sea Turtle Rehabilitation Facility	IP	IP	IP	N/A	N/A	N/A	IP	N/A	N/A	IP	IP
Lancha Sea Turtle Mitigation Plan	N/A	IP	IP	N/A	IP	IP	N/A	IP	N/A	N/A	IP
Laguna Vista Rookery Island Habitat Protection	IP	IP	IP	IP	IP	IP	IP	IP	IP	N/A	IP
Jones Bay Oystercatcher Habitat Restoration	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP
San Antonio Bay Bird Island	IP	IP	IP	IP	IP	IP	IP	C	IP	IP	IP
Texas Breeding Shorebird and Seabird Stewardship	IP	IP	IP	N/A	N/A	N/A	IP	N/A	N/A	IP	IP
Bird Island Cove Habitat Restoration - Construction	IP	IP	IP	IP	IP	IP	IP	C	IP	IP	IP
Bahia Grande Channel F Hydrologic Restoration	IP	IP	IP	IP	N/A	N/A	IP	IP	N/A	N/A	IP
Follets Island Habitat Acquisition Phase 2	IP	IP	IP	IP	N/A	N/A	N/A	N/A	IP	IP	IP
Galveston Island Habitat Acquisition	IP	IP	IP	IP	N/A	N/A	N/A	N/A	IP	IP	IP

- Complete (C): this status indicates that the requirements have been met and a response was received from the appropriate agency(ies).
- In Progress (IP): this status indicates that compliance reviews are anticipated to be required and/or have been requested but an answer has not yet been received the regulatory agency(ies).
- No Effect (NE): this status indicates that the Texas TIG determined there is no effect from the preferred alternative to species or habitats protected under the ESA, MSFCMA, NHPA, or MMPA.
- Phased compliance (Ph): this status indicates that, for a preferred alternative, compliance will need to be re-evaluated later, after initial planning has occurred and locations and methodologies for the work are determined. The Texas TIG will fully evaluate the potential effects once the initial planning is complete.
- Statute not applicable to alternative (N/A): this status indicates that the statute is not applicable to a preferred alternative, often due to the scope and/or location of the activities to be carried out under the alternative.

5.1 Preliminary Finding of No Significant Impact

In the RP/EA #2, the Texas TIG addresses NEPA requirements by tiering from environmental analyses conducted in the Final PDARP/PEIS, evaluating existing analyses, and preparing environmental consequences analyses for the alternatives as appropriate. Based on the programmatic analysis provided by the Final PDARP/PEIS, consideration of the environmental consequences in this document, and the proposed mitigation measures, the Texas TIG's preliminary findings indicate that the alternatives evaluated in this document would not result in any significant impacts on the human environment in accordance with the guidelines for determining the significance of proposed federal actions (40 CFR Section 1508.27). If, after public comments are addressed and the preliminary findings are confirmed, the Texas TIG will issue a FONSI appended to the Final RP/EA.

5.2 Additional Federal Laws

Additional federal laws may apply to the alternatives considered in the RP/EA #2. Legal authorities applicable to restoration alternative development were fully described in the context of the DWH restoration planning in the Final PDARP/PEIS (DWH Trustees 2016a; Section 6.9 and Appendix 6.D). This document incorporates that material by reference.

Examples of applicable laws or EOs include, but are not limited to, the list below. Additional detail on each of these laws or EOs is available in Chapter 6 of the Final PDARP/PEIS (DWH Trustees 2016a).

- ESA (16 USC Section 1531 et seq.)
- Magnuson-Stevens Act (16 USC Section 1801 et seq.)
- MMPA (16 USC et seq.)
- Coastal Zone Management Act (16 USC et seq.)
- NHPA (16 USC Section 470 et seq.)
- Coastal Barrier Resources Act (16 USC et seq.)
- CAA (42 USC Section 7401 et seq.)
- Federal Water Pollution Control Act (CWA, 33 USC Section 1251 et seq.)
- Rivers and Harbors Act (33 USC Section 401 et seq.)
- Marine Protection, Research and Sanctuaries Act
- Estuary Protection Act
- Archaeological Resource Protection Act
- National Marine Sanctuaries Act
- Farmland Protection Policy Act
- Paperwork Reduction Act (44 USC Section 3501 et seq.)
- EO 11988: Floodplain Management (now as augmented by EO 13690, January 30, 2015)
- EO 11990: Protection of Wetlands
- EO 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (now as augmented by EO 14008, January 27, 2021)
- EO 12962: Recreational Fisheries
- 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

5.3 Additional State Laws

Additional state laws may apply to the alternatives considered in the RP/EA #2. Potentially applicable state laws may include but are not limited to:

- Texas Natural Resources Code (TNRC)
- Coastal Public Lands Management Act (TNRC 33.001 to 33.663)
- Dune Protection Act (TNRC 63)
- Open Beaches Act (TNRC 61)
- Texas Parks and Wildlife Code (TPWC)
- Texas Water Code (TWC)
- Texas Health and Safety Code (THSC)

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APPENDICES

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APPENDIX A

Monitoring and Adaptive Management (MAM) Plans

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Bird Island Cove Habitat Restoration – Construction

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The Bird Island Cove Habitat Restoration - Construction Project (project) is located in West Galveston Bay at the mouth of Ostermayer Bayou, around and in front of Shell Island Point, Bird Island Cove, and McAllis Point (Figure 1). This project would protect sensitive estuarine marshes from continued erosion via finalization of E&D, construction of a breakwater, and monitoring. This project would include 1) completion of the final engineering design, conducting and updating surveys, and preparing a solicitation; 2) construction of riprap concrete or limestone breakwaters adjacent to the shoreline of Bird Island Cove, Ostermayer Bayou, and Shell Island Point; and 3) monitoring.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Restore and conserve habitat
- **Restoration Type:** Wetlands, Coastal, and Nearshore Habitats
- **Restoration Approach:** Create, restore, and enhance coastal wetlands
- **Restoration Technique**: Create or enhance coastal wetlands through placement of dredged material; construct breakwaters
- **Trustee Implementation Group:** Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Wetlands, Coastal, and Nearshore Habitat restoration type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to coastal habitats are as follows:

- Restore a variety of interspersed and ecologically connected coastal habitats in each of the five Gulf States to maintain ecosystem diversity, with particular focus on maximizing ecological functions for the range of resources injured by the spill.
- Restore for injuries to habitats in the geographic areas where the injuries occurred, while considering approaches that provide resiliency and sustainability.
- Restore habitats in appropriate combinations for any given geographic area.

The project restoration objective is to reduce the shoreline erosion rates, provide habitat for fish and invertebrates, and create intertidal wetland elevations.

1.3 Conceptual Setting

The Bird Island Cove Habitat Restoration - Construction Project is located in West Galveston Bay at the mouth of Ostermayer Bayou, around and in front of Shell Island Point, Bird Island Cove, and McAllis Point. In Galveston Bay, estuarine marsh loss is due to several factors, including subsidence due to geologic faults activated by underground liquid extraction, increased wave action due to increased storm events, sea-level rise, and insufficient natural sediment supply (White and Morton 1997; White, Morton, and Holmes 2002; Yeager et al. 2007). Beach, dune, and marsh creation projects like the Bird Island Cove Habitat Restoration - Construction Project may help to build and maintain these habitats over time. Additional information about the conceptual setting for the Bird Island Cove Habitat Restoration - Construction Project is summarized in Section 3.3.1 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., sediment compaction or vegetation success). For the Bird Island Cove Habitat Restoration - Construction Project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2.0 and 3.0 summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Sea level rise and subsidence	Increased water levels would reduce the ability of the breakwaters to act as a protection feature and expose marsh habitat to more wave action, creating additional subsidence. In addition, increased water levels in the marsh habitat would increase the depth and duration of flooding of backbarrier plant species and cause stress.
2	Sediment compaction	Unpredicted compaction may lower the elevation of the breakwaters causing it to become subtidal earlier than expected in the project's life.
3	Success of vegetation establishment/plantings	Lack of vegetation establishment/planting success on the potentially created marsh mounds would limit or delay the creation of the desired habitat and allow for sediments to be windblown.
4	Frequency of tropical weather	Project was designed for historical average tropical weather. Increased activity or increased intensity of storm(s) would negatively affect the project by accelerated loss in elevation and sediments.
5	Structure stability	The structures' ability to remain functional and stable over time while being exposed to all environmental conditions such as, but not limited to, sun, water, waves, tropical activity, and temperature.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate, and are further discussed in Section 5.0.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Parameter(s)*	Method	Timing, Frequency, and Duration of Data Collection	Sample Size/Sites	Performance Criteria	Potential CorrectiveActions
Project Objective: To reduce the shoreline erosion rates, provide habitat for fish and invertebrates, and create intertidal wetland elevations through the construction of breakwaters, and potentially a flotation channel and marsh mounds.					
Spatial extent (LF) of the breakwater – to determine how many LF of the breakwaters met the engineering and design requirements.	Using geo-rectified aerial imagery; collect topographic survey data using Real-Time Kinematic (RTK) Global Positioning System (GPS) and/or Light Detection and Ranging or Laser Imaging Detection and Ranging (LiDAR) technology or an equivalent methodology. The crest elevation, cross-section, length, location, and gradation will all be measured and recorded to ensure the project has been built, and will remain (over at least five years) consistent with the engineering and design specifications. In addition, the existing conditions of the breakwater will be documented with photographs.	Aerial imagery will be acquired immediately post-construction/as-built to represent year (YR) 0. Years (YRs) 1–5 postconstruction will be conducted at least once every year.	Sample size: The entire length of each installed breakwater. Sites: N/A – however, the photo locations along the breakwater should be consistent throughout the monitoring period and will determined during the first post-construction survey (YR 0).	The breakwaters spatial extent and elevation should still be within the engineering and design criteria at the end of the five-year monitoring period.	Adjustments of the breakwaters may be required to meet the engineering specifications.
Structural integrity and function of the breakwater – to ensure proper installation and functionality of the breakwaters, as compared to the engineering and design requirements, and to track the integrity of the structure over time.	The breakwaters' structural integrity will be assessed visually by boat, inspecting for damage or structural weaknesses. Photos will be taken of the breakwater at specific photo points that will be established after construction. Subsidence of the structure will be measured using rod and standpipe readings from settling plates installed along the length of the breakwater. The breakwaters' function will be assessed based on data collected from parameter #4.	The breakwater will be inspected immediately after construction to compare the breakwater to the as-builts. Visual inspections will continue at least once a year for the five years following construction. In addition, the breakwater should be inspected after any major storm event.	Sample Size: A total of at least 6 visual survey should be recorded. Sites: Entire area of the breakwater, and photographs at each established photo point.	The breakwaters should be structurally sound and functioning to reduce shoreline subsidence.	Adjustments of the breakwaters or additional structures may be required to reduce shoreline erosion.

Parameter(s)*	Method	Timing, Frequency, and Duration of Data Collection	Sample Size/Sites	Performance Criteria	Potential CorrectiveActions
Nekton/epibenthos abundance, density, and composition – to determine the abundance, density and composition of nekton/epibenthos utilizing the breakwater over time.	Lift nets to sample small/medium crustaceans and fish on the marsh platform and in shallow open water habitat for density and diversity estimations (Rozas 1992). If working in a marsh platform, use of a drop sampler is recommended. Seines should be used to sample small/medium crustaceans and fish along the marsh edge or in shallow open water habitat for abundance estimations.	One sampling event will occur prior to construction activities in the vicinity (within the same footprint of the breakwaters) of the proposed breakwaters and at reference sites to establish a baseline. One sampling event will occur immediately after construction is completed (i.e., YR 0 [as-built] and once a year for the following five years [YR 1–5]).	Sample Size: To be determined. Sites: The areas around the breakwaters, and at least two reference sites.	The density and diversity of nekton and epibenthos species should meet or exceed that of a nearby reference site.	Adjustments to interstitial space in the breakwaters may be required to increase nekton/epibenthos habitat, or additional/different substrates used to augment the habitat at the breakwater.
Shoreline Position	Potential methodology for capturing this parameter could include, but is not limited to: 1.Aerial photographs (including drone/UAV platforms) will be taken to document features and conditions pre- and post-construction and over the five-year monitoring period. Aerial photographs will be analyzed with a geographic information system to determine the extent of shoreline erosion. 2.Use of LiDAR to map the extent of shoreline erosion. This is an optical remote sensing technology that measures the distance and angle of surface reflectance. Ground control points should be established to calculate accuracy and ground surveys may be needed to develop ecosystem specific correction factors in densely vegetated marshes. For additional information on the use of LiDAR, see Brock et al. (2002), Hladik and Alber (2012), and Schmid et al. (2011).	The initial data collection would occur prior to construction to document pre-construction conditions, and data collection would occur annually, during the same time of year, during the five-year monitoring period. The rate of erosion /accretion would be calculated at least once during the project monitoring period.	Sample Size: Project area Sites: Project Area	The shoreline retreat rate has decreased from the documented pre-construction rate of two feet per year.	An investigation into the cause of increased, or sustained erosion will occur to determine the cause of continued habitat loss. After the study, the Trustees will evaluate the potential solutions for project improvements.

* Core project performance monitoring parameters are denoted in bold lettering.

3.0 Adaptive Management

Due to the nature of this project, and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas TIG does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Pre-Execution Monitoring Year -1	Execution Monitoring (initial) As-Built Year 0	Post-Execution Monitoring Year 1	Post-Execution Monitoring Year 2	Post-Execution Monitoring Year 3	Post-Execution Monitoring Year 4	Post-Execution Monitoring Year 5
Spatial Extent		X	X	X	X	X	X
Structural Integrity and Function		X	X	X	X	X	X
Nekton/Epibenthos	X	X	X	X	X	X	X
Shoreline Position	X	X	X	X	X	X	X

Note: X are required data acquisitions; O are optional.

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets) using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustee will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a quality assurance and quality control (QA/QC) review. Before submitting the monitoring data and information package, the Implementing Trustee shall confirm that the package is approved for submission. The Implementing Trustee will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustee will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

TGLO will be the Implementing Trustee for the project.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptive management.

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Bahia Grande Channel F Wetland Restoration

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project is being implemented as restoration for the DWH oil spill Natural Resource Damage Assessment (NRDA), consistent with the PDARP/PEIS (DWH Trustees, 2016). The Bahia Grande Channel F Wetland Restoration Project (project) is located within the Laguna Atascosa National Wildlife Refuge between Bahia Grande and Laguna Vista, Texas (Figure 1). The Bahia Grande System is a federally protected 10,000-acre estuary and wetland complex consisting of three shallow water basins (i.e., Bahia Grande, Little Laguna Madre, and Laguna Larga). This project will enhance 800 acres of wetlands and shallow open waters by restoring freshwater flow from north of Highway 100 to Laguna Larga in the upper Bahia Grande System. This project's primary activities include 1) final engineering design and solicitation for construction, 2) land grading and construction of a conveyance channel, and 3) monitoring.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Restore and conserve habitat
- **Restoration Type:** Wetlands, Coastal, and Nearshore Habitats
- **Restoration Approach:** Create, restore, and enhance coastal wetlands
- **Restoration Technique:** Restore hydrologic connections to enhance coastal habitats
- **Trustee Implementation Group:** Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oyster; Sea Turtles; and Birds*.

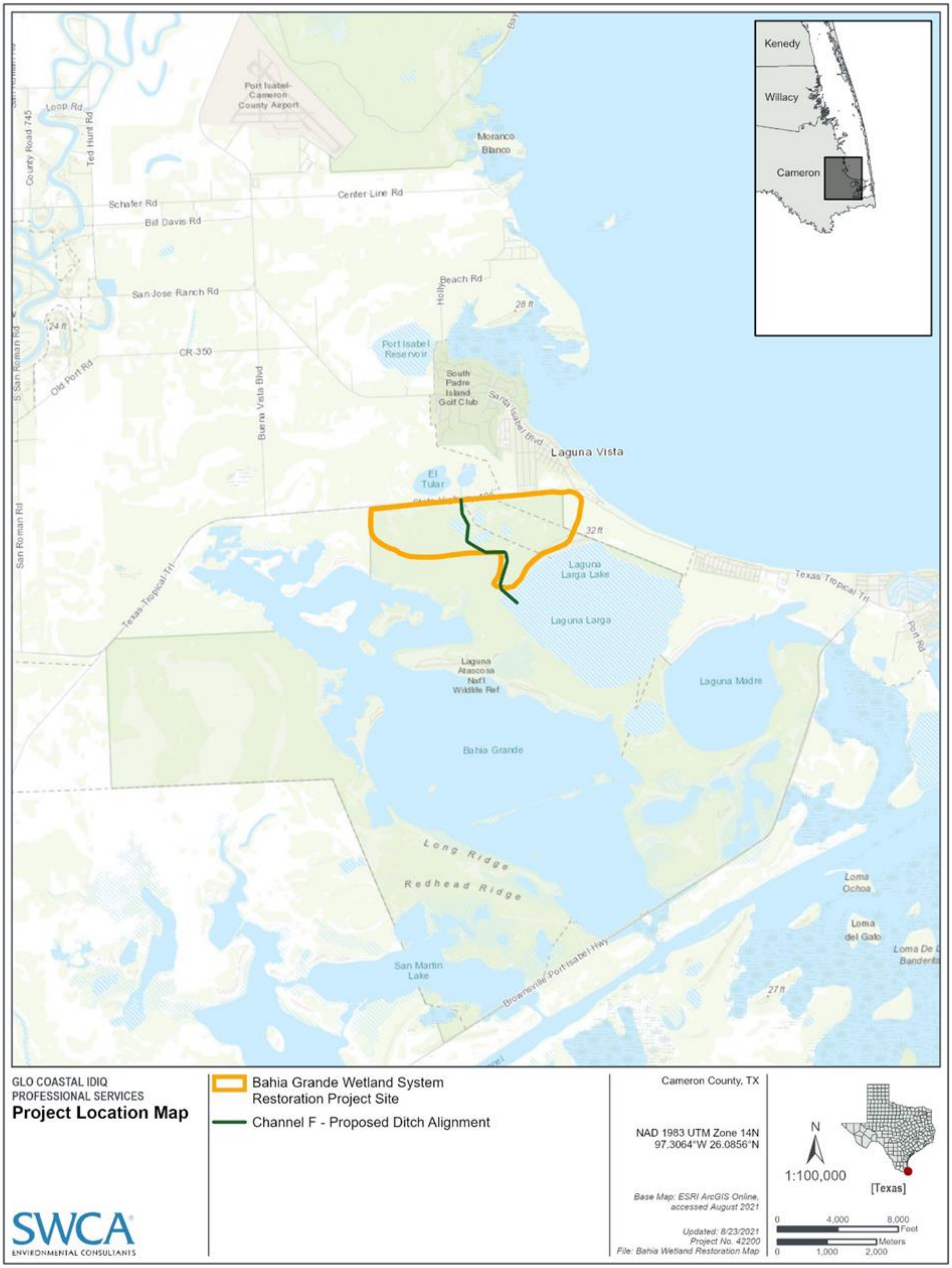

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Wetlands, Coastal, and Nearshore Habitat restoration type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to coastal habitats are as follows:

- Restore a variety of interspersed and ecologically connected coastal habitats in each of the five Gulf states to maintain ecosystem diversity, with particular focus on maximizing ecological functions for the range of resources injured by the spill, such as oysters, estuarine-dependent fish species, birds, marine mammals, and nearshore benthic communities.
- Restore for injuries to habitats in the geographic areas where the injuries occurred, while considering approaches that provide resiliency and sustainability.
- While acknowledging the existing distribution of habitats throughout the Gulf of Mexico, restore habitats in appropriate combinations for any given geographic area. Consider design factors, such as connectivity, size, and distance between projects, to address injuries to the associated living coastal and marine resources and restore the ecological functions provided by those habitats.

The restoration objective for the project is to restore the natural flow of fresh water to Laguna Larga in order to restore salinity gradients. Restoring salinity gradients will enhance the ecological value of existing coastal habitats, which would allow for colonization of vegetation native to the natural salinity regime and creation of habitat conditions that enhance habitat utilization by benthic infaunal and epifaunal as well as nektonic faunal communities.

1.3 Conceptual Setting

The Bahia Grande System served as a natural nursery for fish, shellfish, wildlife, and waterfowl in the South Texas coastal region until the basin was modified by the placement of dredged sediments from the construction of the Brownsville Ship Channel in the mid-1930s and subsequently by the construction of State Highway 48 in the mid-1950s. This isolation left the Bahia Grande System a vast flat of dry sediment with little to no value as habitat for fish and wildlife. In the early 2000s, the USFWS proposed to flood Bahia Grande by cutting in a channel from the Brownsville Ship Channel. The pilot channel was constructed in 2005 and flooded Bahia Grande; since then, additional hydrologic connection improvements have consisted of a bridge constructed on State Highway 48 and another DWH NRDA project (Bahia Grande Hydrologic Restoration [Portal ID #99; https://www.gulfspillrestoration.noaa.gov/project?id=99]) that widened and deepened the existing pilot channel between Bahia Grande and the Brownsville Ship Channel. These previous and ongoing efforts to restore the Bahia Grande System have resulted in improvements to the broader ecosystem. However, the ecological value of Laguna Larga is degraded in nature due to continued impacts of landscape and watershed alterations that prevent historical freshwater inflows from contributing to the Laguna Larga water budget. Given these conditions, DWH Natural Resource Damage Assessment (NRDA) Texas TIG recognized the need re-establish natural freshwater inflows in order to benefit the habitat value of Laguna Larga, which contributes to the overall ecological functioning of the Bahia Grande ecosystem. Restoration of fresh water inflow to Laguna Larga would be accomplished by the modification of ditches, installation of box culverts under Highway 100, and the construction of a conveyance channel (Channel F) to route water flow into Laguna Larga. Land grading would be needed to ensure the desired water flow into Laguna Larga. Reestablishing freshwater inflow to Laguna Larga would complement the tidal flow restoration between the Brownsville Ship Channel and the Bahia Grande.

Key factors that could affect the success of this project include 1) delays or prevention of completion of construction activities due to ongoing or unforeseen market pressures, and 2) the ability to sufficiently grade the landscape between Highway 100 and Laguna Larga to make an effective elevation gradient. This restoration project will re-establish natural fresh water inflows, but the effectiveness of these hydrologic reconnections will also depend on external drivers with could affect achievement of project objectives. Examples of these external drivers include, but are not limited to, 1) changes in precipitation patterns (e.g., amounts, durations, frequency of events, etc.) which limit the amount of fresh water available for Laguna Larga to receive and thus impact salinity regimes; 2) changes in sea level which affect the elevation gradient needed to divert fresh water; 3) floral and faunal colonization or recruitment patterns that prevent establishment of appropriate communities despite establishment of salinity regimes; and 4) the severity and/or frequency of major storm events that degrade and/or cause failure of the hydrologic restoration design features.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated. For this project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2.0 and 3.0 summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS restoration type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Extreme weather	Extreme weather may result in damage to the project prior to, during, or postconstruction. This could result in the need to postpone construction or reconstruct damaged portions of the project.
2	Recruitment and/or colonization patterns	Recruitment and/or colonization patterns of floral and/or faunal communities may be insufficient.
3	Precipitation patterns	The volume of fresh water necessary to effectively alter the Laguna Larga water budget (and salinity regime) will depend on external drivers such as precipitation.
4	Sea level rise	Site-specific rates of sea level rise will impact the proper functioning of the elevation gradient needed to divert fresh water to Laguna Larga.
5	Market instability	Unforeseen market instability may delay or prevent construction of the project.
7	Elevation gradient	The ability to sufficiently grade the landscape between Highway 100 and Laguna Larga will impact the level of success of the project.

This list is not exhaustive; additional uncertainties may be identified as the project is implemented and monitored. These uncertainties may affect the achievement of the restoration objectives of the project. For example, environmental conditions that influence fresh water inflow patterns can vary at different spatial and temporal scales, and might not remain consistent throughout the life of the project. If any drivers or stressors are negatively impacting the project, adaptive management may be necessary to ensure that project objectives are being achieved. The adaptive management strategy for this project is outlined in Section 3.0 section below.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions and/or adaptive management, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate, and are further discussed in Section 5.0.

Project monitoring for ‘Restore targeted salinity regime’ and ‘Provide habitat for fish and invertebrate species’ objectives will be coordinates so that relevant environmental information is paired with fish and invertebrate assemblage information for assessment of project success.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Restore hydrologic connectivity	Elevation	Topographic profiles will be done to measure land elevation by using RTK GPS surveys.	Monitoring shall occur prior to construction, immediately after construction (as-built), and annually post-construction for 5-years or longer to ensure that the elevation gradient is being maintained sufficiently to meet the performance criteria.	Topographic profiles should be collected along the entire project footprint (typically collected for a larger area). A reference and/or control site could be established, where appropriate and applicable.	Elevation gradient will be compared to construction drawings to determine if gradient was constructed and is functioning as designed.	Evaluate if the design should be modified to prevent degradation of the desired gradient, then regrade as appropriate.
	Channel Dimensions	Cross-sectional profiles will be measured using advanced survey instrumentation, such as RTK GPS	Monitoring shall occur immediately following construction (as-built), and 5-years post-construction to ensure channel dimensions are being maintained sufficiently to meet performance criteria. Additional sampling may be needed after large storm events.	Cross-sectional profiles should be measured in the constructed channel constructed. A reference and/or control site could be established, where appropriate and applicable.	Channel dimensions will be compared to construction drawings to determine if gradient is functioning as designed.	Should channel dimensions not be constructed as designed, the channel should be reconstructed to match construction specifications.
	Discharge	Calculate discharge by multiplying the water velocity (m/s) by the cross-sectional area (m^2) of the channel.	Sampling events should capture both high- and low-flow water conditions, but year-round data collection for 1 or more years is preferred to fully capture the seasonal variability in flow conditions. For discrete measurements, the discharge could be assessed over a few weeks during both high- and low-flow conditions.	Discharge should be measured or calculated at the Channel F inlet to Laguna Larga. If discharge is calculated by multiplying the water velocity by the cross-sectional area, these two measurements should be taken in the same location. A reference and/or control site could be established, where appropriate and applicable	Discharge will be evaluated against design criteria to ensure that the channel is not functioning outside of desired conditions (i.e., dewatered or frequently experiencing overbank flooding).	Should discharge be functioning outside of desired conditions, a hydrological analysis should be conducted to determine the cause of failure. Then, appropriate actions should be taken to remedy the situation.

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Restore targeted salinity regime	Temperature	Will be obtained using a temperature probe. Data collection and calibration procedures of detection instruments will be determined by the respective instrument's quality assurance/quality control (QA/QC) procedures.	Quarterly. 30-minute sampling intervals over two-day deployments. Sampling shall occur pre-implementation, immediately after implementation, and post implementation for a total of five years.	Measurements should occur in two locations: 1) the restored inlet of Channel F into Laguna Larga and 2) The middle of Laguna Larga.	Temperature should be evaluated against regional averages for similar habitats.	Should temperature be outside of the desired range, Implementing Trustee shall determine if the freshwater inflows are sufficient for the water budget and make appropriate corrective actions.
	Salinity	Water salinity will be measured continuously with an in-situ multiparameter sonde and data logger.	Quarterly. 30-minute sampling intervals over two-day deployments. Sampling shall occur pre-implementation, immediately after implementation, and post implementation for a total of five years.	Measurements should occur in two locations: 1) the restored inlet of Channel F into Laguna Larga and 2) The middle of Laguna Larga.	Surface water salinity shall be evaluated against requisite conditions for desirable, native flora and fauna to colonize the restored area.	Should salinity be outside of the desired range, Implementing Trustee shall determine if the freshwater inflows are sufficient for the water budget and make appropriate corrective actions.
	Dissolved Oxygen (DO)	Water DO will be measured continuously with an in-situ multiparameter sonde and data logger.	Quarterly. 30-minute sampling intervals over two-day deployments. Sampling shall occur pre-implementation, immediately after implementation, and post-implementation for five years.	Measurements should occur in two locations: 1) the restored inlet of Channel F into Laguna Larga and 2) The middle of Laguna Larga.	DO shall be evaluated against requisite conditions for desirable, native flora and fauna to colonize the restored area.	Should DO be outside of the desired range, Implementing Trustee shall determine if the freshwater inflows are sufficient for the water budget and make appropriate corrective actions.

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Colonization of vegetation native to the natural salinity regime	Percent Cover, Vegetation	Establish plots within the project area and record plot locations with a GPS and/or mark the plots with corner poles to allow for revisiting over time. See EPA (2011) for additional guidance on performing visual estimates of vegetation percent cover. Typical plot sizes are 0.25 to 1 m^2 for SAV, 1 to 4 m^2 for herbaceous vegetation. Data collected should include: • Visual assessment of total vegetation percent cover of target and undesirable species • Percent cover by layer (e.g., herbaceous, shurbs, canopy), percent cover of native species, or percent cover of invasive species, if present. • Percent cover of individual species.	Monitoring should occur pre-implementation, immediately after implementation, and annually post-implementation during peak growing season for 5 years.	Vegetation percent cover should be measured throughout the entire project footprint. For hydrologic restoration projects, transects typically go from areas of higher hydrologic influence to areas of lower hydrologic influence. A reference and/or control site could be established, where appropriate and applicable.	Vegetation percent cover should be evaluated against percent cover of a suitable reference site that contains desirable, native flora.	Should percent cover be outside of desired conditions, Implementing Trustee should determine the cause of undesirable conditions (i.e., salinity, hydrology, etc.). Doing so will inform potential corrective actions.
	Community Composition, Vegetation	Calculate for species diversity.	Monitoring should occur pre-implementation, immediately after implementation, and annually post-implementation during peak growing season for 5 years.	Monitoring should occur throughout the Project footprint so that an accurate representation of community composition is obtained. Monitoring locations should include areas of varying hydrologic influence.	Vegetative community composition shall be evaluated against the composition of a suitable reference site that contains desirable, native flora.	Should community composition be out of desirable conditions (i.e., lacks diversity or contains high levels of invasive species), Implementing Trustee shall determine if conditions are favorable for native species. If conditions are not favorable, corrective actions should be taken to ensure that native species can thrive.

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
	Density, Vegetation	Use a quadrat to estimate plant species density within a defined area (e.g., 1 × 1-m plots or 2 × 2–m plots). Data recorded by collecting number of plants per unit area in the planted area typically include: • Species identification • Density of native species • Density of invasive species if present.	Monitoring should occur pre-implementation, immediately after implementation, and annually post-implementation during peak growing season for 5 years.	Monitoring should occur throughout the Project footprint so that an accurate representation of density is obtained. Monitoring locations should include areas of varying hydrologic influence.	Vegetation density shall be evaluated against a suitable reference site that contains desirable, native flora.	Should vegetation density be outside of desired conditions (i.e., primarily invasives), corrective actions that increase density of native species shall be taken (i.e., removing non-native, invasive species).

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Provide habitat for fish and invertebrate species	Density, Epibenthic and/or Infaunal Organisms	Use cores (15-cm diameter, 15-cm depth) to sample infaunal invertebrates, washing samples over a 2 mm or smaller mesh (Baggett et al. 2014).	Sampling to occur quarterly for 5 years, for a total of 20 samples per year. Monitoring to occur for one year pre-implementation, and immediately following construction for 4 years.	A minimum of 5 sample sites located throughout the project footprint. Each sample will consist of 4 replicate cores. (Total of 400 samples across 5 years of sampling.)	Density of epibenthic or infaunal organisms shall be evaluated against regional averages for similar habitats and preconstruction conditions.	Assess if habitat conditions (i.e., salinity regime) are sufficient for anticipated species density.
	Community Composition, Epibenthic or Infaunal Organisms	Use cores (15-cm diameter, 15-cm depth) to sample infaunal invertebrates, washing samples over a 2-mm or smaller mesh (Baggett et al. 2014).	Sampling to occur quarterly for 5 years, for a total of 20 samples per year. Monitoring to occur for one year pre-implementation, and immediately following construction for 4 years.	A minimum of 5 sample sites located throughout the project footprint. Each sample will consist of 4 replicate cores. (Total of 400 samples across 5 years of sampling.)	Community composition of epibenthic or infaunal organisms shall be evaluated against regional averages for similar habitats and preconstruction conditions.	Assess if habitat conditions (i.e., salinity regime) are sufficient for anticipated community composition.
	Diversity, Epibenthic or Infaunal Organisms	Use cores (15-cm diameter, 15-cm depth) to sample infaunal invertebrates, washing samples over a 2 mm or smaller mesh (Baggett et al. 2014).	Sampling to occur quarterly for 5 years, for a total of 20 samples per year. Monitoring to occur for one year pre-implementation, and immediately following construction and for 4 years post-construction.	A minimum of 5 sample sites located throughout the project footprint. Each sample will consist of 4 replicate cores. (Total of 400 samples across 5 years of sampling.)	Diversity of epibenthic or infaunal organisms shall be evaluated against regional averages for similar habitats and preconstruction conditions.	Assess if habitat conditions (i.e., salinity regime) are sufficient for anticipated species diversity.
	Abundance, Nekton/epibenthos	Bag seines (18.3m L x 1.8m H with #5 multifilament mesh)	Sampling to occur quarterly for 5 years, for a total of 20 sampling events per year. Monitoring to occur for one year pre-implementation, and immediately following construction for 4 years.	A minimum of 5 fixed sample sites located throughout the project footprint at each sampling event. Each sample will consist of 4 replicate cores. (Total of 400 samples across 5 years of sampling.)	Abundance of epibenthic or infaunal organisms shall be evaluated against regional averages for similar habitats and preconstruction conditions.	Assess if habitat conditions (i.e., salinity regime) are sufficient for anticipated species abundance.

3.0 Adaptive Management

Due to the nature of this project and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas TIG does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Pre-Execution Monitoring Year -1	Execution Monitoring (initial) As-Built Year 0	Post-Execution Monitoring Year 1	Post-Execution Monitoring Year 2	Post-Execution Monitoring Year 3	Post-Execution Monitoring Year 4
Elevation	X	X	X	X	X	X
Channel dimensions		X	X	X	X	X
Discharge		X	X	X	X	X
Temperature	X	X	X	X	X	X
Salinity	X	X	X	X	X	X
Dissolved oxygen (DO)	X	X	X	X	X	X
Percent cover, vegetation	X	X	X	X	X	X
Community composition, vegetation	X	X	X	X	X	X
Density, vegetation	X	X	X	X	X	X
Density, epibenthic or infaunal organisms*	X	X	X	X	X	X
Community composition, epibenthic or infaunal organisms*	X	X	X	X	X	X

Monitoring Parameters	Pre-Execution Monitoring Year -1	Execution Monitoring (initial) As-Built Year 0	Post-Execution Monitoring Year 1	Post-Execution Monitoring Year 2	Post-Execution Monitoring Year 3	Post-Execution Monitoring Year 4
Diversity, epibenthic or infaunal organisms*	X	X	X	X	X	X
Abundance, epibenthic or infaunal organisms*	X	X	X	X	X	X

*To be measured quarterly.

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets), using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustee will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a QA/QC review. Before submitting the monitoring data and information package, the Implementing Trustee shall confirm that the package is approved for submission. The Implementing Trustee will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustee will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

NOAA will be the Implementing Trustee for the project.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management and analysis, report writing, and adaptive management.

11.0 References

Baggett, L.P., S.P. Powers, R. Brumbaugh, L.D. Coen, B. DeAngelis, J. Greene, B. Hancock, and S. Morlock. 2014. *Oyster Habitat Restoration Monitoring and Assessment Handbook*. Arlington, Virginia: The Nature Conservancy.

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Follets Island Habitat Acquisition Phase 2

Version 1.0
February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The Follets Island Habitat Acquisition Phase 2 Project (project) is located on Follets Island, which is a USFWS-recognized nationally significant coastal barrier ecosystem in Brazoria County, Texas. Its northern coastline abuts Christmas Bay, which is a designated coastal preserve, and Drum Bay borders the northwest coastline (Figure 1). This project proposes to obtain and conserve approximately 350 acres of wetland, coastal, and nearshore habitats on Follets Island, Texas, in perpetuity through fee-simple acquisition for inclusion to the existing Follets Island Coastal Management Area (CMA).

The proposed project would include 1) securing the property with a purchase contract; 2) the completion of due diligence including appraisal, environmental assessment, survey, and title search; and 3) property transfer to TPWD for inclusion in the Follets Island CMA.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal**: Restore and conserve habitat
- **Restoration Type:** Wetlands, Coastal, and Nearshore Habitats
- **Restoration Approach(s):** Protect and conserve marine, coastal, estuarine, and riparian habitats
- **Restoration Technique(s):** Conserve lands for natural resource values or ecological services
- **Trustee Implementation Group:** Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

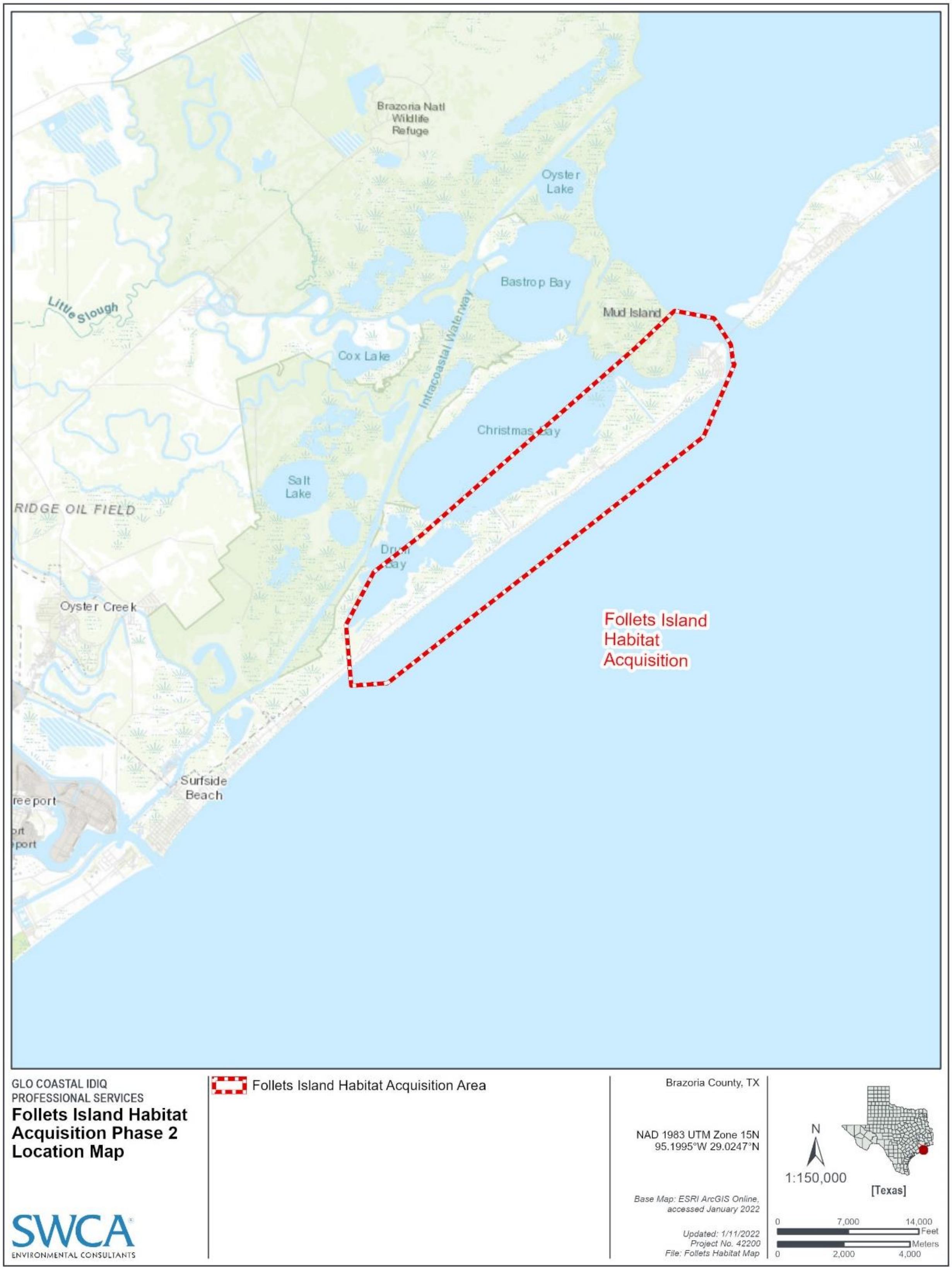

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Wetlands, Coastal, and Nearshore Habitat restoration type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to wetlands, coastal, and nearshore habitats are as follows (DWH 2016):

- Restore a variety of interspersed and ecologically connected coastal habitats in each of the five Gulf states to maintain ecosystem diversity, with particular focus on maximizing ecological functions for the range of resources injured by the spill.
- Restore for injuries to habitats in the geographic areas where the injuries occurred while considering approaches that provide resiliency and sustainability.
- Restore habitats in appropriate combinations for any given geographic area.

The project-specific objective is to prevent future development and degradation of the ecological values of 350 acres of wetland, coastal, and nearshore habitats on Follets Island, Texas, and to maintain its current ecological services into the future.

1.3 Conceptual Setting

Follets Island supports a diversity of wildlife within its marsh, mud flat, beach, dune, and other suitable habitat. Moreover, important foraging, roosting, and nesting habitat for multiple federally protected species are located on the island. Since 2011, the number of beach development permits on Follets Island has steadily increased (Texas TIG 2017), putting significant pressure on the island’s natural resources. Conveying this property to TPWD would conserve coastal habitat with a high development risk in perpetuity. By acquiring and preserving land on a coastal island, this project would benefit multiple resources such as sea turtles, shorebirds, coastal marshes, dunes, and beaches. This project will benefit flora and fauna by enlarging the amount of protected habitat adjacent to Christmas Bay. This acquisition will protect existing habitat corridors and prevent any future development. This project would also enhance the human experience by providing access to passive recreational activities (e.g., fishing from the shore and wildlife viewing). The diversity of habitats on this tract increases the longevity of benefits derived from this project in consideration of coastal sea level rise.

See the Follets Island Habitat Acquisition in Texas RP/EA #1 (Texas TIG 2017) for supplementary background on the historical and current conditions of the area. Additional information about the conceptual setting for the Project is summarized in Section 3.3.3 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., inability to the environmental assessment due to access issues). For the proposed project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2.0 and 3.0 summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Ability to acquire the land	The willingness of the existing property owners to sell decreases, or the appraised value of the target tracts increases unexpectedly, and the Texas Conservation Partners are unable to buy the land.
2	Increased use of the area	The public is not following recreation use guidelines at the site, causing unintended environmental damage (i.e. tramping sensitive habitat, disturbing sensitive species, etc.).
3	Unsatisfactory due diligence	The due diligence exercise could result in information (such as pervasive environmental contamination) that would detour the buyer from purchasing the property due to potential liability issues.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 2. Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)	Method	Timing, Frequency, and Duration of DataCollection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
To prevent future development and degradation of the ecological values of 350-acres of wetland, coastal, and nearshore habitats on Follets Island, Texas, and to maintain its current ecological services into the future	**Number of acres protected – to document the amount of habitat acquired for protection**	Acreage would be determined during the required boundary survey as reflected in the closing documents. The data product would include electronic scans of the closing documents and a shapefile.	The acreage of land protected will be calculated one time after the property has been purchased	Sample size: Area of the property acquired Sites: Area of the property acquired. Boundary information for the land acquired will be documented.	Data analysis is not necessary to meet the project objective or performance criteria	N/A
	Acreage of each habitat type – to document baseline conditions of the natural resources (acreage of habitat types) associated with the land parcel acquired for protection	Evaluation of habitat on the property will occur by using any of the following techniques or combination of techniques or similar methods listed below: • Texas Ecosystem Analytical Mapper (http://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/) • Soil survey • National Wetlands Inventory • Aerial photography • Ground-truth field surveys The data product would include a shapefile.	The data collection and report would occur once the property has been transferred to TPWD, within one year after closing.	Sample size: Area of the property acquired Sites: Area of the property acquired	Data analysis is not necessary to meet the project objective or performance criteria	N/A

3.0 Adaptive Management

Adaptive management on specific land acquisition activities being implemented for this project is not anticipated. Stewardship activities are the responsibility of TPWD or subsequent receiving conservation entity.

4.0 Evaluation

Data analysis is not necessary to meet the project objective or performance criteria.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 1). As there are no post-execution monitoring activities planned, corrective actions are not necessary for this project.

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Pre-Execution	Execution	Post-Execution Monitoring (ongoing)
Number of acres protected		X	N/A
Acreage of each habitat type		X	N/A

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets) using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustee will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a quality assurance and quality control (QA/QC) review. Before submitting the monitoring data and information package, the Implementing Trustee shall confirm that the package is approved for submission. The Implementing Trustee will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustee will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

TPWD will be the Implementing Trustee for the project.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptive management.

11.0 References

Deepwater Horizon Oil Spill NRDA Trustees (DWH). 2016. *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS). Available at: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed November 10, 2021.

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Texas Trustee Implementation Group (Texas TIG). 2017. *Texas Trustee Implementation Group Final 2017 Restoration Plan/Environmental Assessment: Restoration of Wetlands, Coastal, and Nearshore Habitats; and Oysters* (Texas RP/EA #1). Available at: https://www.gulfspillrestoration.noaa.gov/sites/default/files/DWH-ARZ000631.pdf. Accessed December 29, 2021.

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Galveston Island Habitat Acquisition

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The Galveston Island Habitat Acquisition Project (project) is located on Galveston Island adjacent to Starvation Cove and Mentzel Bayou in Galveston County, Texas (Figure 1). Galveston Island is a barrier island that acts as protection for coastal wetland, and nearshore habitat, and it supports a large number of bird species throughout the year by providing breeding and foraging grounds and migratory stopover habitat. The project proposes to contribute to the conservation of approximately 142 acres of barrier island habitat on Galveston Island, Texas, in perpetuity through a conservation easement.

This proposed project would include 1) the completion of due diligence including appraisal, land surveys, title searches, and an Environmental Site Assessment (ESA) Phase I audit; 2) realty closing and associated signatures, and transferring ownership to an external partner, Artist Boat (a local nonprofit organization whose mission is to promote awareness and preservation of coastal margins and the marine environment, and which has successfully conserved over 600 acres on west Galveston Island [Artist Boat 2021]); and 3) continued monitoring in accordance with this approved MAM plan.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Restore and conserve habitat
- **Restoration Type:** Wetlands, Coastal, and Nearshore Habitats
- **Restoration Approach(s):** Protect and conserve marine, coastal, estuarine, and riparian habitats
- **Restoration Technique(s)**: Conserve lands for natural resource values or ecological services
- **Trustee Implementation Group**: Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Wetlands, Coastal, and Nearshore Habitat restoration type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to wetlands, coastal, and nearshore habitats are as follows (DWH 2016):

- Restore a variety of interspersed and ecologically connected coastal habitats in each of the five Gulf states to maintain ecosystem diversity, with particular focus on maximizing ecological functions for the range of resources injured by the spill.
- Restore for injuries to habitats in the geographic areas where the injuries occurred, while considering approaches that provide resiliency and sustainability.
- Restore habitats in appropriate combinations for any given geographic area.

The project restoration objective is to prevent future development and degradation of the ecological values of the property and to maintain its current ecological services into the future.

1.3 Conceptual Setting

Galveston Island is a barrier island that acts as protection for coastal wetland and nearshore habitat, and it supports a large number of bird species throughout the year by providing breeding and foraging grounds and migratory stopover habitat. The proposed acquisition will support protection of approximately 142 acres of connected barrier island coastal and wetland habitats that would be part of an approximately 1,250-acre conservation network of adjacent properties. The coastal wetland habitats targeted for acquisition support a large number of bird species throughout the year as breeding, foraging, and migratory stopover habitats. Additionally, this project provides coastal resiliency benefits by preventing development and degradation of this portion of the barrier island. Additional information about the conceptual setting for the project is summarized in Section 3.3.4 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., inability to the environmental assessment due to access issues). For the proposed project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2.0 and 3.0 summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Ability to acquire the land	The willingness of the existing property owners to sell may decrease, and the Implementing Trustee is unable to purchase and transfer ownership to Artist Boat.
2	Increased use of the area	With Artist Boat ownership, public recreation at the site may increase, causing unintended environmental damage (i.e., trampling sensitive habitat, disturbing sensitive species, etc.).
3	Unsatisfactory due diligence	The due diligence exercise could result in information (such as pervasive environmental contamination) that would deter the buyer from purchasing the property due to potential liability issues.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)*	Method	Timing, Frequency, and Duration of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Document the amount of habitat acquired for protection	Number of acres protected	Acreage would be determined during the required boundary survey as reflected in the closing documents	The acreage of land protected will be calculated one time after the property has been purchased	Area of the property acquired	Data analysis is not necessary to meet the project objective or performance criteria	N/A
Document baseline conditions of the natural resources (acreage of habitat types) associated with the land parcel acquired for protection	Acreage of each habitat type (on the acquired property is determined and mapped)	Evaluation of habitat on the property includes aerial photographic interpretation and ground-truth site visits of the property	The acreage of land protected will be delineated one time after the property has been purchased	Area of the property acquired	Data analysis is not necessary to meet the project objective or performance criteria	N/A

3.0 Adaptive Management

Adaptive management on specific land acquisition activities being implemented for this project are not anticipated. Stewardship activities are the responsibility of the receiving conservation entity (Artist Boat).

4.0 Evaluation

Data analysis is not necessary to meet the project objective or performance criteria.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2). As there are no post-execution monitoring activities planned, corrective actions are not necessary for this project.

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Pre-Execution	Execution	Post-Execution Monitoring (ongoing)
Number of acres protected	N/A	X	N/A
Acreage of each habitat type on the acquired property is determined and mapped	N/A	X	N/A

Note: X are required data acquisitions; O are optional.

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets), using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustee will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a quality assurance and quality control (QA/QC) review. Before submitting the monitoring data and information package, the Implementing Trustee shall confirm with one another that the package is approved for submission. The Implementing Trustee will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustee will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

The Texas Commission of Environmental Quality will be the Implementing Trustee and will work with project partners consisting of the Texas Parks and Wildlife Department (TPWD), Galveston Bay Estuary Program, and the U.S. Fish and Wildlife Service (USFWS).

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptive management.

11.0 References

Artist Boat. 2021. Artist Boat about us webpage. Available at: https://www.artistboat.org/about-us/. Accessed November 2021.

Deepwater Horizon Oil Spill NRDA Trustees (DWH). 2016. *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS). Available at: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed November 10, 2021.

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Petronila Creek Watershed Nutrient Reduction Initiative

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The Texas TIG's restoration planning work for the nutrient reduction restoration type (Parsons 2019) identified three target watersheds, and further narrowed to a group of nine 12-digit HUCs designated as Tier 1 (highest priority) watersheds. These nine Tier 1 watersheds were targeted for nonpoint source reduction strategies. The Petronila Creek Watershed Nutrient Reduction Initiative Project (project) is located in three of these nine Tier 1 watersheds: City of Concordia-Petronila Creek, Gertrude Lubby Lake-Petronila Creek, and Chapman Ranch Lake-Petronila Creek (Figure 1). The project proposes to implement conservation practices on agricultural lands within the boundaries of three 12-digit HUC watersheds to improve water quality conditions at the watershed level. Outreach and financial and technical assistance would be provided to voluntary participants to develop and implement conservation practices on agricultural land that is vulnerable to nutrient and sediment runoff. This project includes 1) landowner outreach and education, 2) conservation planning, 3) E&D and environmental compliance, and 4) conservation practice implementation.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Restore water quality
- **Restoration Type:** Nutrient Reduction (nonpoint source)
- **Restoration Approach:** Reduce nutrient loads to coastal wetlands
- **Restoration Technique**: Agricultural conservation practices
- **Trustee Implementation Group:** Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

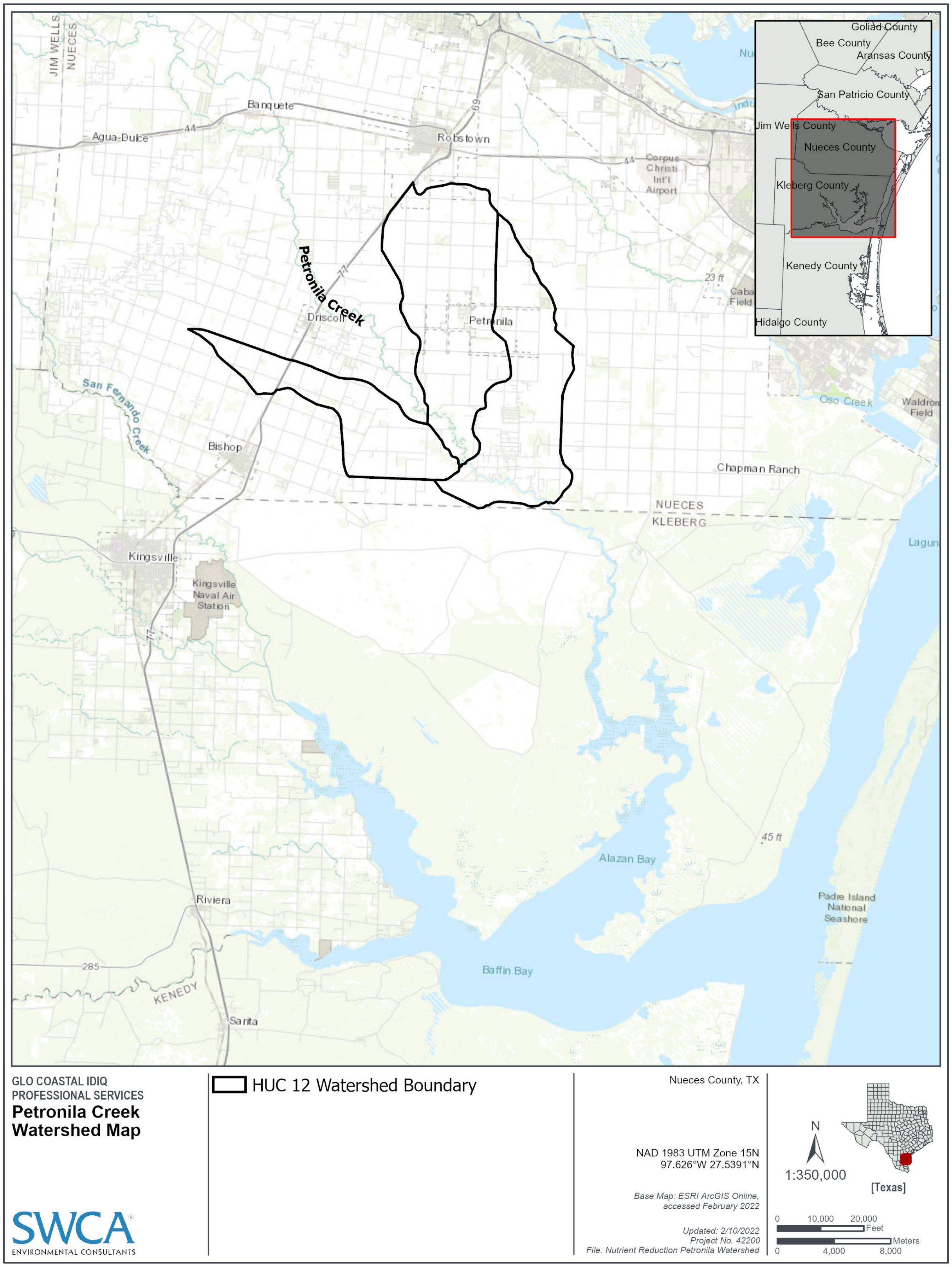

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Nutrient Reduction restoration type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to water quality are as follows:

- Reduce nutrient loadings to Gulf Coast estuaries, habitats, and resources that are threatened by chronic eutrophication, hypoxia, or harmful algal blooms or that suffer habitat losses associated with water quality degradation.
- Where appropriate, co-locate nutrient load reduction projects with other restoration projects to enhance ecological services provided by other restoration approaches.
- Enhance ecosystem services of existing and restored Gulf Coast habitats.

The project's restoration objective is to reduce sediment, phosphorus, and nitrogen loads during storm events leaving private agricultural lands in the Baffin Bay – Petronila Creek watershed.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

Due to the primary land use within the watershed being croplands/agricultural, the main waterbody, Petronila Creek, has been impaired for chloride, sulfates, total dissolved solids, and bacteria for decades (Parsons 2019). These impairments, in combination with other concerns (i.e., high pH, total phosphorous, etc.), are the cause of the degraded water quality of the watershed. Therefore, appropriate site-specific best management practice (BMPs) and/or conservation practices (CPs) are required to help improve water quality throughout the watershed. Aspects of the ecological system within and outside of the Baffin Bay – Petronila Creek watershed that may be affected by implementation of the project will depend on the type of BMPs and/or CPs implemented on the cropland and grazing land. For example, construction of CPs could result in the spread of invasive species near each project site, which would result in a minor, long-term impact to the surrounding environment. Another example includes the effects of grassed waterways on terrestrial species. Installation of grassed waterways could potentially cause short-term minor impacts to terrestrial habitats due to potential vegetation clearing. However, there may be long-term beneficial effects, as the grassed waterways may provide additional habitat for certain species, as well as improve downstream aquatic habitats with the improvement of localized water quality. At the time of the drafting of this plan, specific project locations and BMPs/CPs have not yet been identified, and this MAM plan will need to be updated to include a more robust analysis of the conceptual setting.

In addition, subsequent environmental review will need to occur to determine whether a planned site-specific action is below the maximum impacts described in the RP/EA#2 (Texas TIG 2022). If the site-specific action is below the maximum impacts described in the RP/EA#2, the analysis of the effects will be documented and reviewed by the Implementing Trustee, and the action will proceed. Any associated documentation will be routed through the Texas TIG to the administrative record, where it will be publicly available. If the evaluation of the planned site-specific action indicates the effects are likely to exceed the maximum impacts described in the RP/EA#2, the Texas TIG will undertake additional site-specific environmental review consistent with the National Environmental Policy Act requirements and other requirements for protection of the environment. The Texas TIG does not propose to take actions that would result in any significant adverse impacts on the environment.

Additional information on the conceptual setting for the Petronila Creek Watershed Nutrient Reduction Initiative is summarized in Section 3.4.2 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting, from unknown conditions in the future, or from project elements that do not perform as anticipated (e.g., sediment compaction or vegetation success). For the Petronila Creek Watershed Nutrient Reduction Initiative, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. The below sections summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Willingness of landowners to participate	It is assumed that the USDA would be able to attract farmers and landowners to participate in the development and implementation of BMPs/CPs. However, anticipated participation for the proposed projects was not gauged before the project was assessed by the Texas TIG and is unknown. A lack of participation by landowners would impact the overall goals of nutrient and sediment loading reduction in the watershed.
2	Linkages between water quality improvements and ecosystem benefits	Linkages in this specific watershed to water quality and ecosystem health are not fully understood. It may be possible that specific projects do not result in immediate or significant improvements to ecosystem health.
3	Pollutant transport and freshwater flow through Gulf coastal watersheds	With increased flooding events, freshwater flow regimes through the watershed may change, which may alter the effectiveness of specific projects. Changes in flow patterns could result in additional nonpoint source water quality impacts to occur.
4	Degree to which local improvements in water quality contribute to water quality improvements downstream	The degree to which local improvements in water quality at the cropland and grazing land contribute to water quality improvements downstream is not fully known at this time. If the linkages are not strong, then project implementation may not be able to significantly reduce sediment and nutrient loading in the watershed.

As the projects are implemented and ongoing success monitoring is conducted, project uncertainties may become apparent. Additional discussion and specific details regarding how uncertainties may affect the project should be added to this MAM plan.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Reduce sediment, phosphorus, and nitrogen loads during storm events leaving private lands in the Baffin Bay – Petronila Creek watershed	Number of installed CPs and BMPs on cropland and grazing land.	The recommended methodology for monitoring this parameter is to count the number of improvements implemented at each cropland and grazing as part of the project. Monitoring of this parameter should occur on-site through direct observation of the implemented CPs and BMPs. One observation is sufficient to record this parameter; follow-up visits to the participating cropland and grazing land for data collection would not be necessary unless changes to the CPs and BMPs are made after initial implementation.	Throughout the implementation period of specific projects, and after construction of CPs/BMPs on the landowner(s) property.	To be determined	Increased number of installed CPs and BMPs on cropland and grazing land	Adding additional CPs and BMPs to participating agricultural operations, as necessary, to reduce nutrient loading to the Gulf Coast. Increase outreach or approach previously unwilling partners a second time.

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
	Reduction in total nitrogen (TN) and total phosphorus (TP) in receiving waters cropland and grazing land.	The recommended methodology for monitoring this parameter is direct sampling and detection to measure the sum of all forms of phosphorus and nitrogen, including organic and inorganic forms. Guidance for specific water sampling methodology to measure TN can be found in the American Society for Testing and Materials (ASTM) D5176 Volumes 11.01 and 11.02 and the United States Geological Survey (USGS) National Field Manual for the Collection of Water-Quality Data (USGS n.d.). For guidance on potential methodologies to measure TP, see the US EPA Methodologies 300.0, 365.2, 365.3, and 300.1 (EPA 1971a, 1978, 1993a, 1997). Also, for additional guidance, see the Standard Methodologies 4110C and 4110B, and the USGS Methodology for Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldal Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water (National Environmental Methods Index 2011a, 2011b; USGS 2003). Additional information would also be collected when sampling for TN and total phosphorus TP, such as loads (i.e., water level and flow), depth of the sample, and collection method. Further, ammonium nitrogen (NH_4-N), nitrite plus nitrate nitrogen (NO_2-N + NO_3-N), and total Kjeldahl nitrogen (TKN) could be analyzed from the samples. Data collection and calibration procedures of detection instruments would be determined by the respective instrument's quality assurance and quality control (QA/QC) procedures. At this time, the exact locations, types, and amounts of CPs and BMPs are unknown; therefore, it is impossible to establish exact sampling methodologies and guidance in the first version of this MAM plan. However, the project-specific planning, engineering, and design documents would outline the specifics necessary to update this MAM plan to include the locations, frequencies, sample size, and durations of sampling for this monitoring parameter.	To be determined	Sample Size: To be determined Sites: To be determined	Identifiable reduction in TN and TP from cropland and grazing land Need baseline data and/or modeling to compare final vs. initial	Improving project infrastructure (e.g., installing additional nutrient reduction CPs and BMPs). Conducting routine maintenance activities (e.g., inspection/repair of livestock exclusion fencing, maintenance of existing water-control structures**)**

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
	Reduction in total suspended solids (TSS) and turbidity from cropland and grazing land	The recommended methodology for monitoring this parameter is direct sampling and detection to measure the TSS and turbidity. TSS is defined as the dry weight of sediment from the known volume of a sub-sample of the original water sample and is measured as milligrams per liter (mg/L) or parts-per-million (ppm). Turbidity is defined as a measure of intensity of light scatter by a sample, or the cloudiness/haziness of a sample, and is measured in nephelometric turbidity units (NTUs). For methods on collection of TSS, see EPA 160.2, and for methods on assessing water turbidity see EPA 180.1 (EPA 1971b, 1993b) and Wagner et al. (2006). Data collection and calibration procedures of detection instruments would be determined by the respective instrument's QA/QC procedures. At this time, the exact locations, types, and amounts of CPs and BMPs are unknown; therefore, it is impossible to establish exact sampling methodologies and guidance in the first version of this MAM plan. However, the project-specific planning, engineering, and design documents would outline the specifics necessary to update this MAM plan to include the locations, frequencies, sample size, and durations of sampling for this monitoring parameter.	To be determined	To be determined	Identifiable reduction in TSS and turbidity from cropland and grazing land Need baseline data and/or modeling to compare final vs initial.	Improving project infrastructure (e.g., installing additional nutrient reduction CPs and BMPs). Conducting routine maintenance activities (e.g., cleaning and maintaining diversion channels to increase the effectiveness of TSS reduction)
	Area of water quality practices (acres impacted)	The recommended methodology for monitoring this parameter is to measure, in acres, the areas directly impacted by the installation of CPs/BMPs. Monitoring of this parameter should occur both on-site through direct observation of the implemented CPs and BMPs and by measuring the acreages of those improvements. In addition, off-site measurements in terms of receiving waterbodies could also be measured.	After implementation of BMPs/CPs on private lands. Monitoring for acreage of impacts could also continue in tandem with parameters 2 and 3, over a period of time after implementation.	To be determined	Increased area of improvement (in acres) once the project is established, compared to pre-project.	Improving project infrastructure (e.g., installing additional nutrient reduction CPs and BMPs). Conducting routine maintenance activities (e.g., maintaining livestock exclusion fencing in riparian zones).
	Number of contracts (if different from number of installed CPs/BMPs)	The recommended methodology for monitoring this parameter is to count the number of contracts (landowners signed onto the program).	Throughout the implementation period of specific projects.	To be determined	Number of contracts continue to grow on a yearly basis.	Additional outreach to landowners, continued education and communication with communities within the three 12-digit HUCs.

3.0 Adaptive Management

Due to the nature of this project, and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas TIG does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Preconstruction and Planning	Construction	Postconstruction
Number of installed CPs and BMPs on cropland and grazing land			X
Reduction in TN and TP from cropland and grazing land	X		X
Reduction in TSS and turbidity from cropland and grazing land	X		X
Area of water quality practices (acres impacted)			X
Number of contracts	X		

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets), using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustee will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a QA/QC review. Before submitting the monitoring data and information package, Implementing Trustee shall confirm that the package is approved for submission. The Implementing Trustee will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustee will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

The USDA will be the implementing Trustee for the project and is anticipated to work with potential project partners, including landowners.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptive management.

11.0 References

Deepwater Horizon Oil Spill NRDA Trustees (DWH). 2016. *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS). Available at: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed November 10, 2021.

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National Environmental Methods Index. 2011a. *Standard Method 4110C: Anions in Water by Ion Chromatography*. Available at: https://www.nemi.gov/methods/method_summary/5705/. Accessed January 25, 2018.

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Landscape Scale Oyster Restoration in Galveston Bay

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1. Project Overview

The Landscape Scale Oyster Restoration Project (project) is located in the Galveston Bay system, Texas, (Figure 1). The project proposes to restore approximately 50 acres of degraded subtidal and intertidal oyster reefs across the Galveston Bay system. The project would involve construction of a network of intertidal and subtidal reef complexes focusing on Trinity Bay and Upper-Galveston Bay. Focusing restoration efforts in the Galveston Bay system would provide increased benefits due to the multiple restoration efforts cumulatively adding to the resilience of the Galveston Bay oyster meta-population. This project would include 1) site assessment, E&D and permitting, 2) construction, and 3) monitoring.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal**: Replenish and protect living coastal and marine resources
- **Restoration Type**: Oysters
- **Restoration Approach**: Restore oyster reef habitat
- **Restoration Techniques**: Restore or create oyster reefs through placement of cultch in nearshore and subtidal areas
- **Trustee Implementation Group**: Texas TIG
- **Restoration Plan**: *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oyster; Sea Turtles; and Birds*

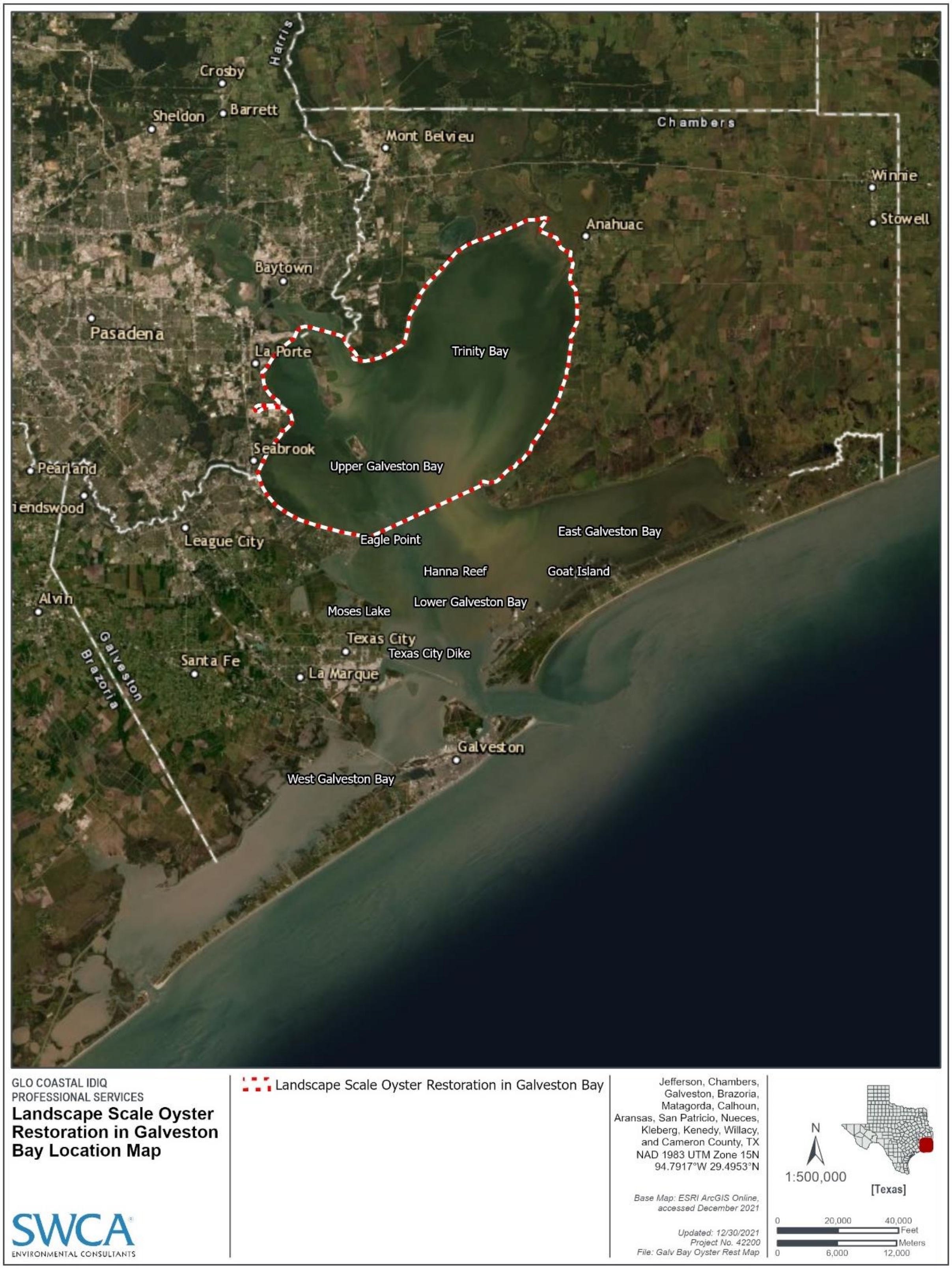

Figure 1. Project location.

1.2. Restoration Type Goals and Project Restoration Objectives

The project is designed to address the Oyster restoration type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to oysters are as follows:

- Restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs
- Restore resilience to oyster populations that are supported by productive larval source reefs and sufficient substrate in larval sink areas to sustain reefs over time
- Restore a diversity of oyster reef habitats that provide ecological functions for estuarine-dependent fish species, vegetated shoreline and marsh habitat, and nearshore benthic communities

The project-specific objective is to create substrate for colonization by oysters and other reef organisms.

1.3. Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

Galveston Bay oyster reefs have been subjected to multiple stressors including heavy commercial harvest pressure; hydrologic alterations due to reduced freshwater inflow and enlargement of the Houston Ship Channel; oyster disease (e.g., *Perkinsus marinus*, i.e., Dermo); pollution; siltation; and predators. The bay's oyster population and reef habitat incurred massive habitat losses when Hurricane Ike passed over Galveston Bay on September 13, 2008. Estimates from Texas Parks and Wildlife Department (TPWD) side-scan sonar surveys indicate that between 50% to 60%, or about 8,000 acres, of the consolidated reefs in Galveston Bay were damaged or destroyed by Hurricane Ike–induced sedimentation. Historically, the Texas eastern oyster fishery was the second largest in the United States, with Galveston Bay accounting for as much as 90% of the Texas landings.

This project will contribute to a reef network within the Galveston Bay system. These reefs will be positioned within the ecosystem so that the predominant currents transport larvae from the restored sanctuaries to sink and non-restored reefs within the bay system. This network approach will allow for increased oyster population sustainability and oyster habitat resiliency while maximizing oyster fisheries benefits through larval supply, transport, and settlement.

1.4. Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., sediment compaction). For the Landscape Scale Oyster Restoration in Galveston Bay Project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Cultch availability and cost	If there is a delay in obtaining reef materials or costs increase, the Project could be impacted by a delay in schedule or a change in project scope (e.g. fewer acres restored).
2	Illegal harvest	Although the reefs are designed to discourage harvest, there is still potential for illegal or legal harvest (depending on location) to occur. This could result in lower than ideal oyster abundance and spawning stock.
3	Extreme weather	As seen following Hurricane Ike in 2008, extreme weather events have the potential to severely impact oyster populations. Sedimentation could occur and damage or destroy constructed reefs.
4	Freshwater inflow	Variations in freshwater and resultant salinity could affect disease (e.g., *Perkinsus marinus*; “Dermo”) and die-off. Should the established network of reefs be subject to disease, oyster die-off could result.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Create substrate for colonization by oysters and other reef organisms	Area - Project footprint	Intertidal reefs - the footprint may be measured using a GPS (MAM Manual Method 2 [modified], page E-18) Subtidal reefs - "the footprint may be measured using side-scan or multi-beam sonar (Baggett et al. 2014) or professional/survey grade echo sounder" (MAM Manual Method 5, page E-19)	At minimum, one time, postconstruction; additional measurements could occur as needed	Footprint of each reef area will be measured	Target acreage achieved	Additional cultch planted
Create substrate for colonization by oysters and other reef organisms	Structural integrity, oysters - reef height	Intertidal reefs - Sampling methods will follow Baggett et al. (2014), with modifications as necessary Subtidal reefs - Bathymetric measurements using sonar equipment	At minimum, one time, postconstruction; additional measurements could occur as needed	Measurements would occur every 1 m along the crest of the reef (every 5 m if reef length is >200 m). (Baggett et al. 2014)	N/A	N/A
Create substrate for colonization by oysters and other reef organisms	Structural integrity, oysters - reef volume	Multiplying reef area by elevation (mean reef height) (MAM Manual Method 1, page E-72)	At minimum, one time, postconstruction; additional measurements could occur as needed	See reef height and project footprint	N/A	N/A
Create substrate for colonization by oysters and other reef organisms	Density, oysters - dead oysters	Density would be measured using quadrats or hydraulic patent tongs (MAM Manual method 2 or 4, page E-40)	Annually for 5 years after construction is complete	Minimum of 5 samples per reef	N/A	N/A
Create substrate for colonization by oysters and other reef organisms	Density, oysters - live oysters	Density would be measured using quadrats or hydraulic patent tongs (MAM Manual method 2 or 4, page E-40)	Annually for 5 years after construction is complete	Minimum of 5 samples per reef	10 oysters per m^2	Transplant oysters; add hatchery seeded cultch
Create substrate for colonization by oysters and other reef organisms	Survival, oysters	Calculation of percent of live oysters on a reef (MAM Manual, page E-74)	Annually for 5 years after construction is complete	Minimum of 5 samples per reef	N/A	N/A
Create substrate for colonization by oysters and other reef organisms	Density, oysters - spat	Density would be measured using quadrats or hydraulic patent tongs (MAM Manual method 2 or 4, page E-40)	Annually for 5 years after construction is complete	Minimum of 5 samples per reef	N/A	N/A

Project Objective	Parameter(s)	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Create substrate for colonization by oysters and other reef organisms	Organism, linear measurement oyster (shell height)	Calipers or ruler would be used to measure shell height	Annually for 5 years after construction is complete	Minimum of 5 samples per reef	N/A	N/A
Create substrate for colonization by oysters and other reef organisms	Salinity	YSI multimeter	During any site visit where sampling occurs	Each reef	N/A	N/A

3.0 Adaptive Management

Due to the nature of this project, and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas TIG does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameter	Pre-Execution Monitoring	Execution Monitoring (as built)	Post-Execution Monitoring Year 1	Post-Execution Monitoring Year 2	Post-Execution Monitoring Year 3	Post-Execution Monitoring Year 4	Post-Execution Monitoring Year 5
Area - project footprint		X					
Structural integrity, oysters - reef height	X	X					
Structural integrity, oysters - reef volume		X					
Density, oysters - dead oysters			X	X	X	X	X
Density, oysters - live oysters			X	X	X	X	X
Survival, oysters			X	X	X	X	X
Density, oysters - spat			X	X	X	X	X
Organism, linear measurement oyster (shell height)			X	X	X	X	X
Salinity			X	X	X	X	X

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets), using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustee will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a quality assurance and quality control (QA/QC) review. Before submitting the monitoring data and information package, the Implementing Trustee shall confirm that the package is approved for submission. The Implementing Trustee will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustee will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

TPWD will be the Implementing Trustee for the project.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptive management.

11.0 References

Baggett, L.P., S.P. Powers, R. Brumbaugh, L.D. Coen, B. DeAngelis, J. Green, B. Hancock, and S. Morlock. 2014. *Oyster habitat restoration monitoring and assessment handbook*. Arlington, Virginia: The Nature Conservancy. Available at: http://www.oyster-restoration.org/wp-content/uploads/2014/01/Oyster-Habitat-Restoration-Monitoring-and-Assessment-Handbook.pdf. Accessed November 18, 2021.

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Upper Texas Coast Sea Turtle Rehabilitation Facility

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The Upper Texas Coast Sea Turtle Rehabilitation Facility Project (project) would be located on Pelican Island in the City of Galveston, Galveston County, Texas, on the Texas A&M University at Galveston (TAMUG) campus, west of Seawolf Parkway (Figure 1). This project would involve the construction of a new sea turtle rehabilitation facility and parking lot on a previously disturbed area of land that was used as a dredge placement facility located directly northwest of the TAMUG Campus Wetland Center. This project would include 1) E&D, 2) construction, 3) provision of equipment and supplies, and 4) monitoring.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Replenish and protect living coastal and marine resources
- **Restoration Type:** Sea Turtles
- **Restoration Approach:** Increase sea turtle survival through enhanced mortality investigation, and early detection of response to anthropogenic threats and emergency events
- **Restoration Techniques:** Enhancement of the Sea Turtle Stranding and Salvage Network (STSSN) for enhanced network response and coordination; enhanced preparedness and response capacity for emergency events; enhanced rehabilitation capability where necessary
- **Trustee Implementation Group:** Texas TIG, RW TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

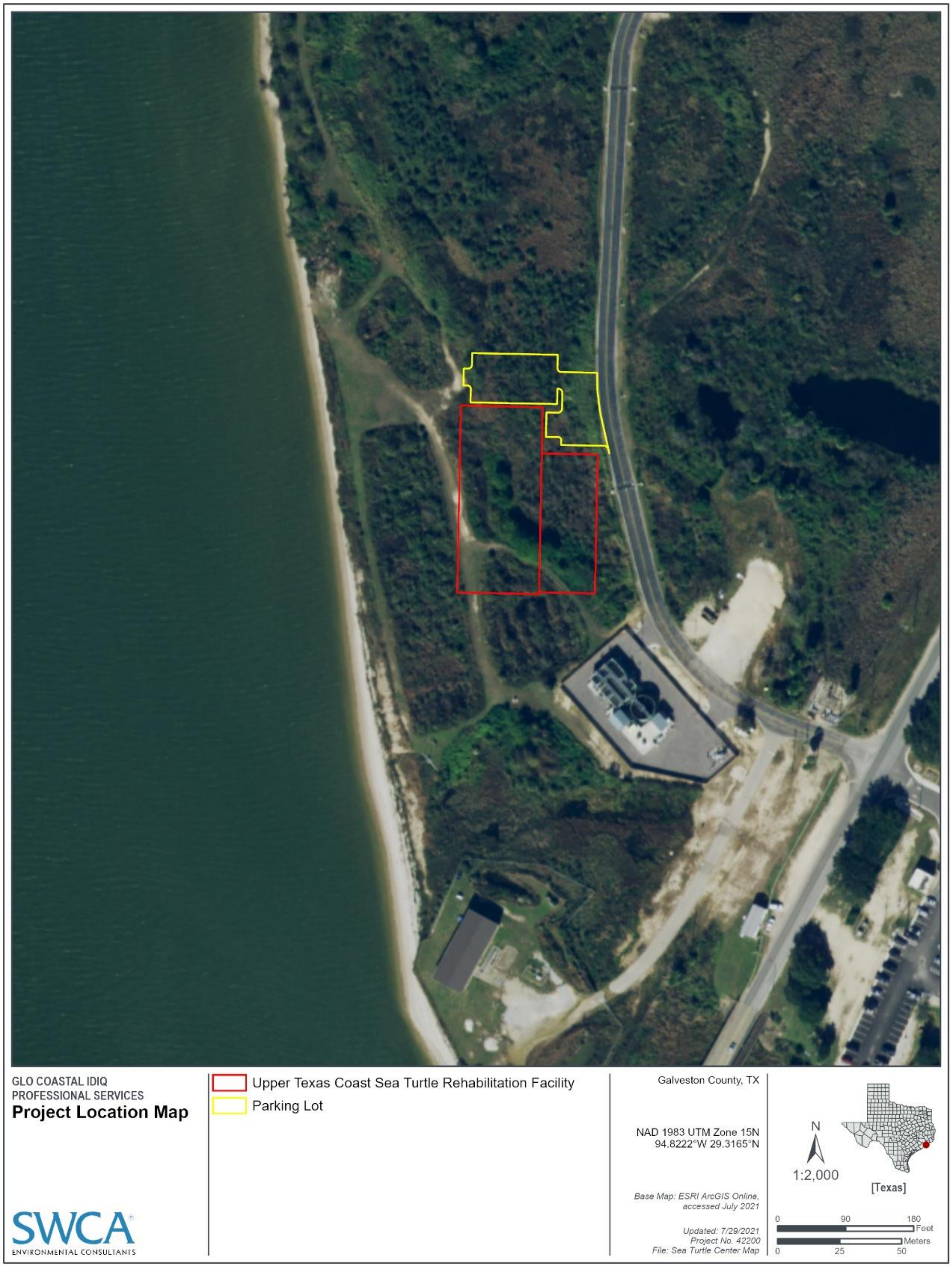

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Sea Turtle restoration type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to sea turtles are as follows:

- Implement an integrated portfolio of restoration approaches to address all injured life stages (hatchling, juvenile, and adult) and species of sea turtles.
- Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restore sea turtles in the various geographic and temporal areas within the Gulf of Mexico and Atlantic Ocean that are relevant to injured species and life stages.
- Support existing conservation efforts by ensuring consistency with recovery plans and recovery goals for each of the sea turtle species.

The restoration objective for the project is to construct the Upper Texas Coast Sea Turtle Rehabilitation Facility on Pelican Island in the City of Galveston, Galveston County, Texas.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

Sea turtles move throughout the Gulf of Mexico and are subject to natural and anthropogenic threats during all life stages and in all habitats. Such threats include vessel strikes and entrapment, which occurs regionwide due to stranding events such as red tides, cold stuns, major freshwater intrusions, and recruitment pulses through inlets and passes (DWH 2021b). Upper Texas coast waters are vital habitat for juvenile and adult Kemp's ridleys, and more Kemp's ridley turtles are found stranded on the upper Texas coast than the lower Texas coast. Waters off the upper Texas coast are part of the critical northern Gulf of Mexico foraging area and migratory corridor for adult Kemp's ridley turtles (Shaver et al. 2013, 2016). Strandings of juvenile green turtles have increased significantly in Texas during recent years (Shaver et al. 2017) and will likely continue to increase in future years. During the winter of 2017–2018 cold stunning event, more than 3,600 cold stunned turtles were recorded in Texas.

Regional rehabilitation centers play a critical role in providing emergency care to injured sea turtles. Following the closure of the NOAA-Galveston laboratory's rehabilitation center, the closest rehabilitation facilities for sea turtles in Texas are located in Corpus Christi, on Mustang Island, and on North Padre Island; both of which are several hundred miles away. Transporting sick or injured sea turtles to the nearest hospital in the Texas Coastal Bend is impractical and would almost certainly increase mortality. Additionally, while the Houston Zoo can assist with initial needs following a stranding, the Houston Zoo is 1.5 hours away and only conducts surgeries and provides short-term critical care and is not equipped for long-term rehabilitation.

It is critical that a new rehabilitation facility be constructed on the upper Texas coast so that it can intake critically endangered Kemp's ridley turtles, rapidly increasing numbers of green turtles, and other sea turtles that wash ashore ill or injured. The NOAA-Galveston Laboratory, Houston Zoo, and Texas A&M

University-Galveston have entered into a temporary agreement to enable transition as the NOAA-Galveston Laboratory exits rehabilitation, but the agreement is temporary and subject to expiration in the near future. Additional information about the conceptual setting for the Upper Texas Coast Sea Turtle Rehabilitation Facility project is summarized in Section 3.6.1 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., sediment compaction or vegetation success). For the Upper Texas Coast Sea Turtle Rehabilitation Facility project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. The sections below summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021a), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Extreme weather	Extreme weather may damage the capability of the STSSN to construct the rehabilitation center on time and within budget.
2	Supply chain	Project implementation is dependent upon the global supply chain to procure construction materials and equipment for the facility. Potential impacts due to COVID-19 may impact the pace of construction. Should delays occur due to supply chain issues, the project may be delayed or subject to increased costs.
3	Attrition	Employee turnover has the potential to slow project implementation while replacement employees are found within participating organizations.
4	Political uncertainty	Because the STSSN is organized by NOAA, a federally funded organization, political factors may play into the amount of resources and funding the organization receives.
5	Funding	Implementation of the project is dependent upon multiple funding sources. Should funding be withheld from one or more sources, project implementation could be delayed until additional funding is procured.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate, and are further discussed in Section 5.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)	Baseline	Method, Timing, Frequency, and Duration	Sample Size/Sites	Final Performance Criteria Used to Determine Project Success	Potential Corrective Actions
Construction of a new rehabilitation and educational outreach facility that will enhance the capabilities of project partners conducting stranding and rehabilitation activities in the Gulf of Mexico	Response capacity: To determine the degree to which the STSSN has increased their response capacity.	Existing response capacity (e.g., number of response events, geographic extent of response area, number of trained personnel, status of field equipment).	Updates shall be made to a tracking document as capacity changes (e.g., as equipment is purchased, sold, decommissioned, or altered in any way). Record response times and geographic locations of responses. Tracking document to be submitted with annual monitoring updates for the duration of the monitoring period (7 years).	Sample size: All equipment that impacts the response capabilities of the facility. All response events. Sites: Upper Texas Coast Sea Turtle Rehabilitation Facility	Percent expansion of response compacity, increase in personnel/ volunteers, and expansion of geographic response area compared to current conditions.	Repair equipment or procure replacements. Enhance recruitment for volunteers.
	Characterization of responses: To determine the type and frequency of responses provided by the rehabilitation facility postconstruction.	Existing activities currently supported by the temporary rehabilitation center as they occur (e.g., response time, species needing assistance and type of response provided). When a turtle cannot be rehabilitated, that inability should also be recorded with a reason for the inability to rehabilitate, such as lack of personnel or capacity.	Responses shall be logged via the STSSN Stranding Report Form and provided as an appendix to annual progress reports with a summary characterizing the responses provided (7 years).	Sample size: All response events conducted Sites: Upper Texas Coast Sea Turtle Rehabilitation Facility	Injured species are receiving benefits from responses coordinated through the facility.	Adjust staff mix or equipment needs to ensure responses to stranding events are successful and timely.
	Rehabilitation capacity: To determine the capacity of the new facility to rehabilitate sea turtles	Existing rehabilitation capacity (e.g., number of turtles held in current facility, number of volunteers, number of tanks, pumps, filtration systems).	Data shall be recorded as patients are admitted and/or discharged from the current rehabilitation facility. Following construction, maintain a log of sea turtles needing rehabilitation. Information should include at a minimum the turtle's species, sex, need for rehabilitation (including any specific diagnosis), and duration of stay/anticipated length of rehabilitation. Information regarding surplus rehabilitation capacity (e.g., holding areas not currently in use) should also be documented to determine the facility's overall use patterns from year to year. Information will be submitted via annual monitoring reports (7 years).	Sample size: All turtles requiring rehabilitation Sites: Upper Texas Coast Sea Turtle Rehabilitation Facility	Percent increase in Injured species are actively being rehabilitated at the facility compared to temporary facility.	Provide rehabilitation services for nearby regions that require assistance. Add additional staff and equipment to support increased capacity. Improve outreach to potential volunteers.

Project Objective	Parameter(s)	Baseline	Method, Timing, Frequency, and Duration	Sample Size/Sites	Final Performance Criteria Used to Determine Project Success	Potential Corrective Actions
	Outcomes of turtles treated: To determine the number and result of turtles that received treatment at the facility.	Existing outcomes of sea turtles treated in temporary facility.	Data shall be recorded as patients are admitted and/or discharged from current facility. Following construction, maintain a log of patients that received care and the outcome of the services provided (e.g., successfully rehabilitated and discharged, rehabilitation not successful (deceased), turtle to remain at facility as educational ambassador, etc.) Information will be submitted via annual monitoring reports (7 years).	Sample size: All turtles requiring rehabilitation Sites: Upper Texas Coast Sea Turtle Rehabilitation Facility	Percent increase in injured species receiving rehabilitation services are being rehabilitated successfully and released into the Gulf of Mexico.	Modify rehabilitation methodologies according to individual need.
	Visitor use and access, number of students participating: To determine the number of visitors at the educational facility and college students participating in programs.	Existing capacity for outreach and education of students	Data shall be recorded for all visitors to the educational exhibits at the facilities and supplemental educational events conducted by facility staff. Maintain a visitor log and student timesheets either through an automated system or manual tracking system. **(5 years).**	Sample size: All visitors participating in educational activities or programs associated with the facility Sites: Upper Texas Coast Sea Turtle Rehabilitation Facility	Members of the public actively participating in the educational opportunities available at the facility and the number of college students participating in programs.	Conduct educational outreach to increase visitor use.

3.0 Adaptive Management

Due to the nature of this project, and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas Trustee Implementation Group (Texas TIG) does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Pre-Execution Monitoring Year -1	Execution Monitoring (initial) As-Built Year 0	Post-Execution Monitoring Year 1	Post-Execution Monitoring Year 2	Post-Execution Monitoring Year 3	Post-Execution Monitoring Year 4	Post-Execution Monitoring Year 5
Response Capacity	X	X	X*	X*	X*	X*	X*
Characterization of Responses	X	X	X*	X*	X*	X*	X*
Rehabilitation Capacity	X	X	X*	X*	X*	X*	X*
Outcome of Turtles Treated			X*	X*	X*	X*	X*

*Not funded by this Texas TIG project

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets) using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustee will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a quality assurance and quality control (QA/QC) review. Before submitting the monitoring data and information package, the Implementing Trustee shall confirm that the package is approved for submission. The Implementing Trustee will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustee will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

TGLO will be the Implementing Trustee. The Implementing Trustee will coordinate the project with TAMUG, the Texas STSSN Coordinator, the Texas TIG, and the RW TIG, which is also providing funding through RW TIG RP/EA #1.

10.0 Monitoring and Adaptive Management Budget

No budget for the project monitoring and adaptive management plan is included. Project monitoring will be funded by the Upper Texas Coast Sea Turtle Rehabilitation Facility’s operational budget, which is not funded through the RP/EA #2.

11.0 References

Deepwater Horizon Oil Spill NRDA Trustees (DWH). 2016. *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS). Available at: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed November 10, 2021.

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Lancha Sea Turtle Mitigation Plan

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The Lancha Sea Turtle Mitigation Plan Project (project) will be conducted in state and federal waters on the southern Texas coast, primarily from Corpus Christi, Texas, to the U.S.-Mexico border (Figure 1). The project would contribute to 1) the purchase of a long-range vessel(s) and 2) enhanced enforcement and/or patrol efforts to apprehend illegal vessels (primarily illegal vessels from Mexico known as lanchas) and remove illegal fishing gear from the water (e.g., gill nets and longline gear). In addition, the alternative may result in the procurement of dock space for vessel(s) used for this project and the installation of a floating dock for those vessel(s).

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Replenish and protect living coastal and marine resources
- **Restoration Type:** Sea Turtles
- **Restoration Approach:** Reduce sea turtle bycatch in commercial fisheries through enhanced state enforcement efforts to improve compliance with existing sea turtle conservation requirements
- **Restoration Techniques:** Increase state fishery enforcement resources
- **Trustee Implementation Group:** Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

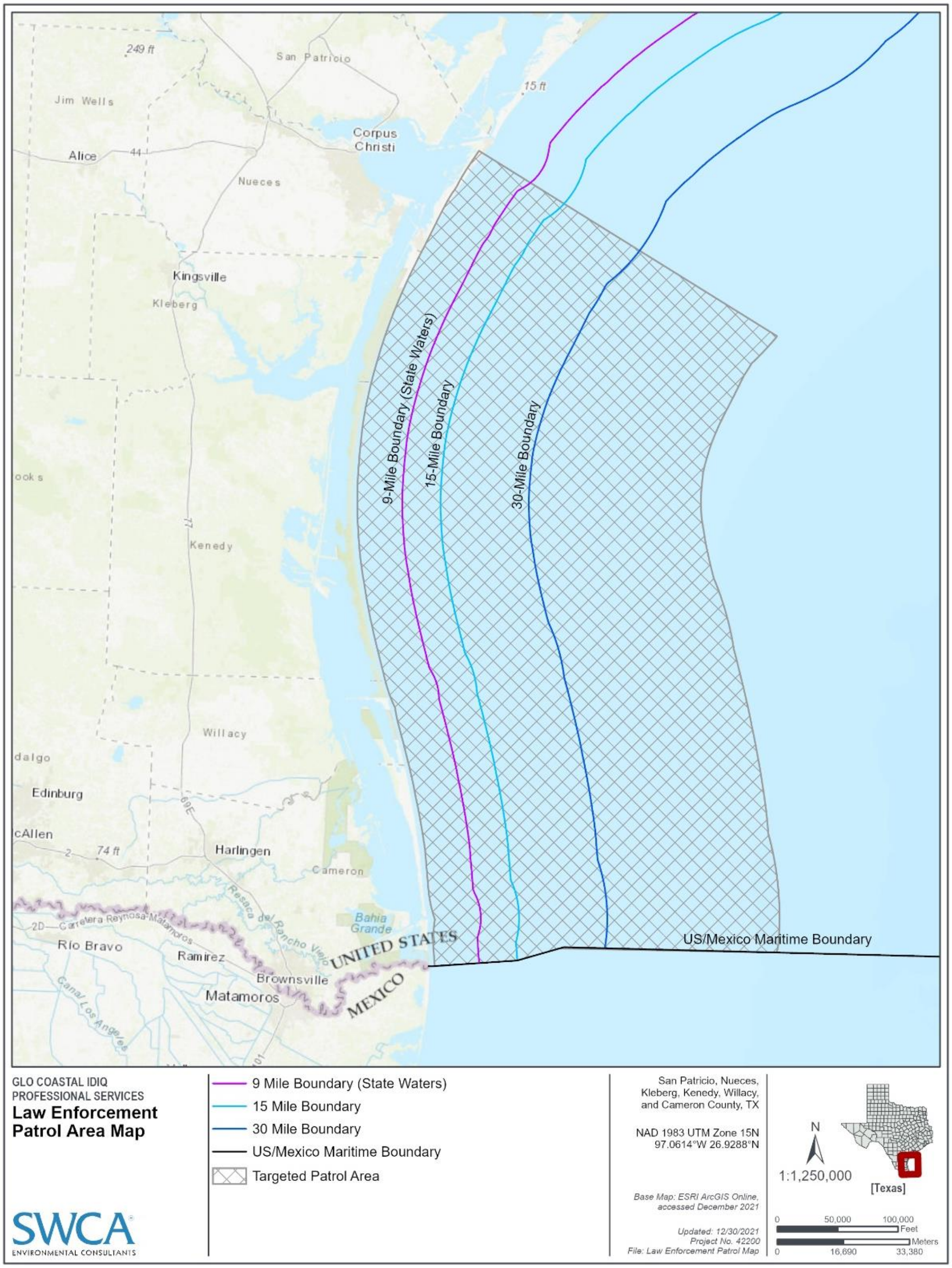

Figure 1. Law enforcement patrol location map.

1.2 Restoration Goals and Project Restoration Objectives

This project is designed to address the Sea Turtle Restoration Type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to sea turtles are as follows:

- Implement an integrated portfolio of restoration approaches to address all injured life stages (hatchling, juvenile, and adult) and species of sea turtles.
- Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restore sea turtles in the various geographic and temporal areas within the Gulf of Mexico and Atlantic Ocean that are relevant to injured species and life stages.
- Support existing conservation efforts by ensuring consistency with recovery plans and recovery goals for each of the sea turtle species.

The primary objective of the project is to reduce sea turtle injuries and mortality caused by use of illegal commercial fishing gear in U.S. waters.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

Bottom longline fishery operated by artisanal fishers from Mexico is depicted typically with the terminal end of the fishing gear consisting of monofilament, connected to a short wire leader, then connected to a circle hook (Figure 2; Stacy et al. 2018).

Figure 2. Comparison of gear recovered from stranded sea turtle (taken from Stacy et al. 2018).

The lancha fleet uses illegal longline gear and gill nets to target red snapper and sharks, incidentally catching and killing sea turtles. This illegal gear is most frequently set 15 to 30 miles offshore, encompassing an approximately 3,000-square-mile offshore area from Corpus Christi in the north to the U.S.-Mexico international maritime boundary in the south (see Figure 1). The project is expected to deter illegal fishing in Texas and federal waters of the Gulf of Mexico. Enforcement activities are anticipated to result in the seizure of illegal fishing vessels and equipment, thereby, reducing deaths associated with illegal fishing and the associated bycatch. Although this project is targeting sea turtles, other species injured by the DWH oil spill such as red snapper and sharks may also benefit from this project. Additional information about the conceptual setting for the project is summarized in Section 3.6.2 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., sediment compaction or vegetation success). For the Lancha Sea Turtle Mitigation Plan Project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. The sections below summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Extreme weather	Extreme weather may temporarily limit or affect the timing of TPWD law enforcement patrols.
2	Supply chain	Project implementation is dependent upon the global supply chain to procure the appropriate equipment (e.g., vessel). Potential impacts due to COVID may impact the pace of project implementation; should delays occur due to supply chain issues, the project may be delayed or subject to increased costs.
3	Attrition	Employee turnover has the potential to slow project implementation while replacement employees are found.
4	Funding	Implementation of the project is dependent upon multiple funding sources. Should funding be withheld from one or more sources, project implementation could be delayed until additional funding is procured.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameters	Method	Timing and Frequency of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Improving sea turtle restoration through equipment enhancements	Equipment enhancements, sea turtles - number acquired or purchased	Count of vessels acquired	One time, following purchase	N/A	Long-range vessel(s) acquired or purchased for use on patrols	Consider purchase of alternative vessel(s) that could complete the task
Enhance state enforcement efforts to improve compliance with existing sea turtle conservation requirements	Vessel patrol hours	Documentation of hours spent patrolling	Monthly	Patrols will occur in areas known to have lanchas	To be determined and approved by the Texas TIG prior to initiation of patrols; will be based on available technology and vessel(s)	Reallocate resources
Enhance state enforcement efforts to improve compliance with existing sea turtle conservation requirements	Vessel patrols	To be determined by law enforcement personnel	Monthly	Patrols will occur in areas known to have lanchas	To be determined and approved by the Texas TIG prior to initiation of patrols; will be based on available technology and vessel(s)	Reallocate resources
Enhance state enforcement efforts to improve compliance with existing sea turtle conservation requirements	Vessel contacts	To be determined by law enforcement personnel	Monthly	Patrols will occur in areas known to have lanchas	N/A	Obtain and evaluate information on lanchas and revise patrolling timing/location
Enhance state enforcement efforts to improve compliance with existing sea turtle conservation requirements	Sea turtle related citations and warnings	To be determined by law enforcement personnel	Monthly	Patrols will occur in areas known to have lanchas	N/A	Obtain and evaluate information on lanchas and revise patrolling timing/location

3.0 Adaptive Management

Due to the nature of this project, and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas TIG does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameter	Pre-Execution Monitoring	Execution Monitoring (as built)	Post-Execution Monitoring (Year 1)	Post-Execution Monitoring (Year 2)	Post-Execution Monitoring (Year 3)	Post-Execution Monitoring (Year 4)	Post-Execution Monitoring (Year 5)
Equipment enhancements, sea turtles - number acquired or purchased		X					
Vessel patrol hours			X	X	X	X	X
Vessel patrols			X	X	X	X	X
Vessel contacts			X	X	X	X	X
Sea turtle related citations and warnings			X	X	X	X	X

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets), using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustee will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a quality assurance and quality control (QA/QC) review. Before submitting the monitoring data and information package, the Implementing Trustee shall confirm that the package is approved for submission. The Implementing Trustee will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustee will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

TPWD will be the Implementing Trustee for the project.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptive management.

11.0 References

Deepwater Horizon Oil Spill NRDA Trustees (DWH s). 2016. *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS). Available at: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed November 10, 2021.

———. 2021. *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0*. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December 2021. Available: http://www.gulfspillrestoration.noaa.gov/. Accessed December 16, 2021.

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Laguna Vista Rookery Island Habitat Protection Project

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The Laguna Vista Rookery Island Habitat Protection Project (project) would be located in lower Laguna Madre about three miles north-northwest of the town of Laguna Vista in Cameron County, Texas. The project would complete engineering and construct approximately 2,250 linear feet (LF) of living shoreline measures to minimize ongoing erosion and restore the shoreline along the perimeter of the 11-acre Spoil Island (Figure 1). This proposed project would protect and restore habitat to benefit colonial waterbirds, including brown pelicans (*Pelecanus occidentalis*), terns (*Sternidae*), skimmers (*Rynchops* sp.), and wading birds. This project would 1) finalize E&D and obtain relevant permits, 2) construct restoration features, and 3) implement monitoring.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Replenish and protect living coastal and marine resources
- **Restoration Type:** Birds
- **Restoration Approach(s):** Restore and conserve bird nesting and foraging habitat; create, restore and enhance barrier and coastal islands and headlands
- **Restoration Technique(s)**: Restore or construct barrier and coastal islands and headlands via construction of offshore breakwaters to prevent erosion; restore coastal islands via placement of dredged sediments
- **Trustee Implementation Group:** Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Birds restoration type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to birds are as follows (DWH 2016):

- Restore lost birds by facilitating additional production and/or reduced mortality of injured bird species.
- Restore or protect habitats on which birds rely.
- Restore injured birds by species where actions would provide the greatest benefits within geographic ranges that include the Gulf of Mexico.

The project restoration objective is to protect and restore the 11-acre rookery island to benefit colonial waterbirds.

1.3 Conceptual Setting

The Laguna Vista Island was created from the placement of dredged sediments during the dredging of one or more now-abandoned navigation channels from historical oil and gas industry activities. The island is an active colonial waterbird rookery island, is currently leased by Audubon Texas, and is managed by the CBBEP. The northeastern portion of the island is vegetated, and the western portion is predominantly non-vegetated flats. Both areas are used as nesting habitat by birds (AECOM 2020). Wind and wave erosion are threatening the bird habitat on the island. The northern shoreline of the island is subject to erosive wave energy produced when cold fronts produce strong northerly winds. Review of recent aerial imagery indicates that erosive wave action causes the loss of approximately 10 feet of the northern shoreline annually, eroding both vegetated and non-vegetated portions of the island (AECOM 2020). In addition to the loss of bird nesting habitat, the nearshore area around the island has experienced degradation of seagrass and oyster habitat from siltation.

Protection and restoration of nesting habitats and increased available food sources, such as what this project proposes, will combat the stressors listed above and increase available, climate-resilient habitat for waterbirds. Following project implementation, it is anticipated that the 11-acre rookery island will see increased colonial waterbird nesting activity, as well as reduced shoreline erosion rates. Additionally, reducing shoreline erosion is expected to have long-term benefits to adjacent seagrass beds by preventing continual deposition of shoreline material onto existing seagrasses. Similarly, existing oyster reefs in the project area would be expected to benefit from a net reduction in turbidity and the increase in hard substrate provided by construction of the breakwater system. Additional information about the conceptual setting for the project is summarized in Section 3.7.1 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., slow or lack of native vegetation growth in the restored areas). For the project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2 0 and 3.0 summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Sea level rise	An increased local rate of sea level rise has the potential to impact the restored shoreline and nesting areas during high tide. Overwash may occur and flood nesting sites and/or decrease access to foraging areas.
2	Response of target birds to the restoration techniques	Even though construction is proposed outside of the breeding season, it is possible that the colonial waterbirds do not immediately take to the restored nesting areas of the island.
3	Occurrence of forage base to support a breeding colony	Impacts due to construction may temporarily reduce the waterbird forage base, which it turn may not be able to support the increased numbers of nesting birds resulting from the restoration.
4	Catastrophic weather	Extreme weather events could damage the restored shoreline and constructed breakwater.
5	Success of vegetation establishment/plantings	Lack of vegetation establishment/planting success on the potentially created marsh mounds would limit or delay the creation of the desired habitat and allow for sediments to be windblown.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if they are needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Laguna Vista Rookery Island currently support colonial nesting birds. The protection and restoration project will enhance opportunities for colonial nesting species and enhance the longevity of the existing island and restored portions of the island. Part of the evaluation of the performance of this project will be to differentiate the benefits of the enhancement actions and the benefits without the enhancement actions. Therefore, comparisons of pre-construction information will be compared to data collected after construction of the island is complete. Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 2. Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)	Method	Timing, Frequency, and Duration of DataCollection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Protect island shoreline and restore island mass	Constructed and existing physical infrastructure of the island	A Professional Engineer (PE) will perform a final inspection and as-built survey to document completion of the project. The project site will be inspected each year of the monitoring period visually and using aerial images.	Once annually during the 5-year monitoring period	The project footprint	No changes to the infrastructure footprint	Changes in the infrastructure footprint will be evaluated by the TIG. Engineers may be used to evaluate changes if they are deemed significant. The TIG may take corrective actions based on engineering recommendations.
Enhance the numbers of colonial nesting birds	The number of nesting pairs of birds	Conduct surveys to enumerate the number of nesting birds at the island from watercraft, aerial platforms, and photographs. Survey methodology will be consistent with methods used in the Texas Colonial Waterbird Society surveys (Damude and LeNoir 2000).	Nesting bird surveys will begin the first nesting season after construction is completed. Monitoring will occur three times each nesting season, once in April, once in May, and once in June for the 5-year monitoring period.	Observations on all nesting habitat	Increased diversity of annual nesting pairs over the performance monitoring period (5 years).	The project may require the use of artificial nesting platforms, decoys, and vocalizations to attract birds to the newly restored island.

3.0 Adaptive Management

Due to the nature of this project, and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas TIG does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Pre-Construction Monitoring Year -1	Execution Monitoring (initial) As-Built Year 0	Post-Execution Monitoring Year 1	Post-Execution Monitoring Year 2	Post-Execution Monitoring Year 3	Post-Execution Monitoring Year 4	Post-Execution Monitoring Year 5
Infrastructure Integrity and Function		X	X	X	X	X	X
Colonial Waterbird Nest Monitoring	X	X	X	X	X	X	X

Note: X are required data acquisitions; O are optional.

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets), using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustees will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a quality assurance and quality control (QA/QC) review. Before submitting the monitoring data and information package, Implementing Trustees shall confirm with one another that the package is approved for submission. The Implementing Trustees will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations inoperation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustees will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

The TGLO and DOI will be the Implementing Trustees and will work with partners including Texas Audubon, USFWS, and the CBBEP. Texas Audubon, as the USACE permit applicant and state-owned-land lease holder, will provide the long-term management of the restored island and breakwater.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptive management.

11.0 References

AECOM. 2020. *Laguna Vista Spoil Island Shoreline Protection Phase I Alternative Analysis*. Texas General Land Office.

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Deepwater Horizon Oil Spill NRDA Trustees (DWH). 2016. *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS). Available at: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed November 10, 2021.

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Jones Bay Oystercatcher Habitat Restoration

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The Jones Bay Oystercatcher Habitat Restoration Project (project) would restore habitat to support American oystercatcher (*Haematopus palliates*) nesting and foraging habitat in Jones Bay, approximately 0.5 mile west of the community of Tiki Island in Galveston County (Figure 1). The project will restore a total of about one acre of nesting habitat on five small existing islands and create six intertidal reef sites totaling approximately 1.5 acres to support foraging needs. The project would provide habitat to support eight additional nesting pairs of oystercatchers and their young. Activities occurring through this project include 1) preparation of the solicitation package and bid review for all four sites; 2) construction of the island reef restoration sites, and breakwater; and 3) monitoring.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Replenish and protect living coastal and marine resources
- **Restoration Type:** Birds
- **Restoration Approach(s):** Restore and conserve bird nesting and foraging habitat; create, restore, and enhance barrier and coastal islands and headlands
- **Restoration Technique(s)**: Create or enhance oyster shell rakes and beds; restore coastal islands via placement of cultch
- **Trustee Implementation Group:** Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Birds restoration type. As summarized in Chapter 5 of the Final PDARP/PEIS, the restoration goals for injuries to birds are as follows (DWH 2016):

- Restore lost birds by facilitating additional production and/or reduced mortality of injured bird species.
- Restore or protect habitats on which birds rely.
- Restore injured birds by species where actions would provide the greatest benefits within geographic ranges that include the Gulf of Mexico.

The project restoration objective is to restore nesting habitat on existing remnant islands and create intertidal reef sites to support foraging needs.

1.3 Conceptual Setting

Uniquely situated between Houston, Texas, and the Gulf of Mexico, Galveston Bay has been severely impacted by climate change. The region's sea-level rise (SLR), one of the highest in the United States, is due to a combination of human-induced subsidence from groundwater withdrawal and eustatic SLR. The National Oceanic and Atmospheric Administration (NOAA) has measured relative SLR of two feet over the past 100 years on Galveston Island (NOAA 2018). Besides negative impacts on regional flooding, rapid SLR has led to a loss of critical habitat for many species, including the American oystercatcher (Enwright et al. 2016).

The American oystercatcher is listed as a species of conservation concern in conservation plans (Brown et al. 2001; USFWS 2021) including the Texas Conservation Action Plan (TPWD 2012). Furthermore, the State of Texas has designated the species as vulnerable due to low population numbers and recent declines.

In Texas, oystercatchers nest primarily on small bay islands where disturbance and predation are low. These islands are also located near foraging areas associated with intertidal reefs. Over several decades, many of the island sites have suffered from erosion and have also decreased in elevation relative to the local mean tide levels. Nesting habitat that provides for successful reproduction is understood to be the primary threat facing breeding populations of American oystercatchers in Texas. Many of the once suitable islands in the Bay are now submerged. GCBO conducted an analysis of island size in Jones Bay from 2009 to 2015 and documented a decrease in nesting island size by up to 60% during this time (Hackney and Heath 2018). Following this analysis, further reductions have been dramatic, rendering three of the original six islands unsuitable for oystercatcher nesting (Hackney and Heath 2018). Additionally, the oystercatcher depends primarily on intertidal reef sites for its food (American Oystercatcher Working Group et al. 2012). Increased water levels associated with these sites have also forced nesting oystercatchers to venture farther for food as intertidal reefs become inaccessible to foraging birds. The number of breeding pairs that use Jones Bay has fallen sharply over the last decade (Hackney and Heath 2018).

Restoration of nesting islands and increased available food sources, such as what this Project proposes, will combat the stressors listed above and increase available, climate resilient habitat for American oystercatcher. Following project implementation, it is anticipated that Jones Bay will be able to sustain up to eight additional nesting pairs of American oystercatcher and up to an additional 1.5 acres of intertidal reef habitat. Additional information about the conceptual setting for the Project is summarized in Section 3.7.2 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., lack of natural invertebrate recruitment at newly constructed reefs). For the Jones Bay Oystercatcher Habitat Restoration Project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2.0 and 3.0 summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Sea level rise	An increased local rate of sea level rise has the potential to impact restored foraging and nesting areas during tidal flooding events. Overwash may occur and flood nesting sites and/or decrease access to foraging areas.
2	Cultch availability and cost	Unavailable or prohibitively expensive cultch could result in project delays or cancellations.
3	Human disturbance	Human disturbance may affect nesting success of oystercatchers.
4	Catastrophic weather	Extreme weather events could damage restored islands or intertidal reefs.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)	Method	Timing, Frequency, and Duration of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Restore five existing islands to support additional nesting habitat for eight pairs of American oystercatchers	Horizontal and vertical spatial extent of restored nesting islands and protective features.	An as-built survey would be performed at the end of construction period. Each site will be visually inspected and photographed using watercraft and on-site visits. Aerial imagery will be used to assess any changes to each nesting island. Tide data would be obtained from the nearest NOAA tide station. Tides at nesting sites would be monitored as well. Persistent elevation benchmarks would be established at each nesting island site.	All nesting islands will be inspected once a year and after significant storm events.	Each of the five nesting islands will be inspected.	There will be up to at least a total of a 0.98 acre footprint for the nesting islands throughout the monitoring period.	Addition of material to any island that has lost material or experience increased probability of overwash.
Restore eight nesting pairs and support juvenile survival	Number of breeding pairs and fledgling rates of restored island nesting oystercatchers.	Methods used here would follow those used in Koczur et al. (2014). Additionally, observations of foraging behavior in created intertidal reef sites will be documented.	All nesting islands will be inspected weekly during the breeding season until juveniles are fledged.	Once weekly	Eight nesting pairs of American oystercatchers and foraging behavior documented on created reef sites.	Use decoys and call tractions to entice birds to nest.
Create intertidal reef foraging habitat that will support eight pairs of American oystercatchers and their offspring	Accessible forage area and food resources on intertidal reef sites.	Document the presence of invertebrates and reef fish species on each reef site. Document foraging behavior and prey capture events by American oystercatchers and their young.	Intertidal reefs should be inspected annually for the presence of invertebrates or fish species. Photographic documentation will be collected. Surveys of reproductive activity and status of oystercatchers will also document foraging and prey selection at intertidal reef sites. Photographs will be taken of these activities.	Each intertidal reef site will be inspected for invertebrate or reef fish presence. Documentation of foraging activity will coincide with oystercatcher surveys.	The presence of a food base and foraging activity by oystercatchers.	The addition of material may be required to enhance the 3-dimensional qualities of the reef sites to provide more invertebrate and reef fish refugia sites.

3.0 Adaptive Management

Due to the nature of this project, and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas TIG does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Execution Monitoring (initial) As-Built Year 0	Post-Execution Monitoring Year 1	Post-Execution Monitoring Year 2	Post-Execution Monitoring Year 3	Post-Execution Monitoring Year 4	Post-Execution Monitoring Year 5
Infrastructure Surveys	X	X	X	X	X	X
AMOY Breeding and Foraging Surveys		X	X	X	X	X
Intertidal Reef Inspections	X	X	X	X	X	X

Note: X are required data acquisitions; O are optional.

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets) using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustees will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a quality assurance and quality control (QA/QC) review. Before submitting the monitoring data and information package, Implementing Trustees shall confirm with one another that the package is approved for submission. The Implementing Trustees will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustees will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

The TGLO will be the Implementing Trustee for construction, and DOI will be the Implementing Trustee for the MAM plan. The Galveston Bay Foundation, as the USACE permit applicant and state-owned-land lease holder, will be responsible for management of the restored islands and created reefs for the anticipated life span of the alternative through a lease with the TGLO.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptative management.

11.0 References

American Oystercatcher Working Group, E. Nol, and R.C. Humphrey (2012). American oystercatcher (*Haematopus palliatus*). In *The Birds of North America*, edited by A. Poole and F. Gill. Philadelphia, Pennsylvania: Academy of Natural Sciences, Washington, D.C.: American Ornithologists' Union.

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Koczur, L.M., A.E. Munters, S.A. Heath, B.M. Ballard, M.C. Green, S.J. Dinsmore, and F. Hernández. 2014. Reproductive Success of the American Oystercatcher (*Haematopus palliatus*) in Texas. *Waterbirds* 37(4):371–380 (1 December). Available at: https://doi.org/10.1675/063.037.0404. Accessed December 2021.

National Oceanic and Atmospheric Administration (NOAA). 2018. Sea Level Trends, Pier 19 in Galveston, TX. Available at: https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8771510. Accessed November 2021.

Texas Parks and Wildlife Department (TPWD). 2012. *Texas Conservation Action Plan 2012 – 2016: Gulf Coast Prairies and Marshes Handbook*. Editor, Wendy Connally, Texas Conservation Action Plan Coordinator. Austin, Texas. Available at: https://tpwd.texas.gov/landwater/land/tcap/documents/gcpm_tcap_2012.pdf. Accessed November 1, 2021.

U.S. Fish and Wildlife Service (USFWS). 2021. *Birds of Conservation Concern 2021: Migratory Bird Program*. Available at: https://www.fws.gov/migratorybirds/pdf/management/birds-of-conservation-concern-2021.pdf. Accessed September 2021.

San Antonio Bay Bird Island Project

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The San Antonio Bay Bird Island Project (project) proposes to create a four-acre island in San Antonio Bay using coastal construction techniques to replace nesting habitat that was historically provided by Seadrift Rookery Island. This proposed project is located within San Antonio Bay, approximately 500 feet north of the Seadrift Boat Channel and 300 feet east of the former Seadrift Rookery Island (Figure 1). This project would include 1) completion of final engineering and design (E&D) and preparation of a solicitation; 2) construction of the island; and 3) monitoring in accordance with this MAM plan over the course of no less than 5 years.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Replenish and protect living coastal and marine resources
- **Restoration Type:** Birds
- **Restoration Approach(s):** Restore and conserve bird nesting and foraging habitat; create, restore, and enhance barrier and coastal islands and headlands
- **Restoration Technique(s)**: Restore coastal islands via placement of dredged sediments; create or enhance oyster shell rakes and beds
- **Trustee Implementation Group:** Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

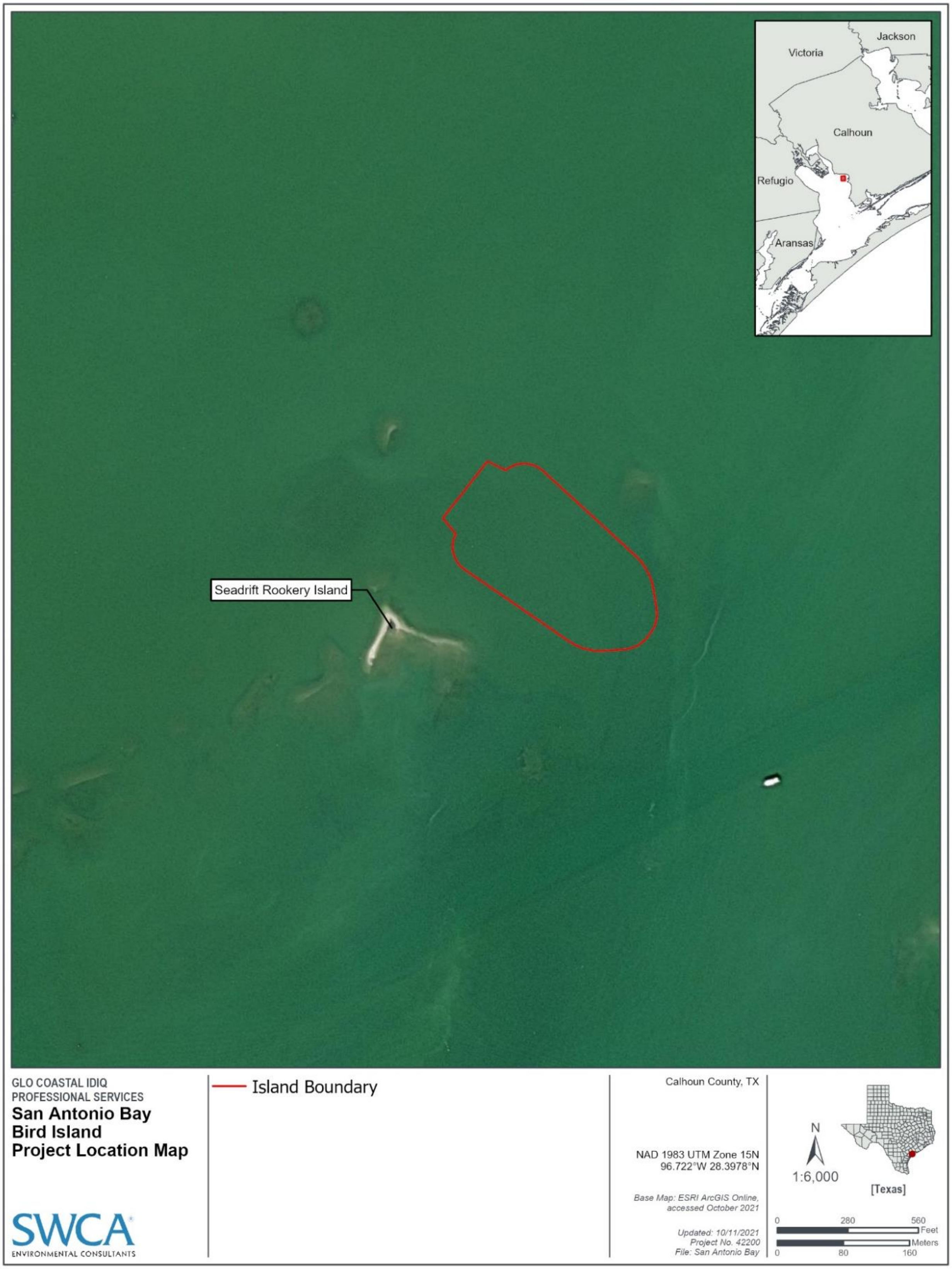

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Birds restoration type. As summarized in Chapter 5 of the PDARP/PEIS, the restoration goals for injuries to birds are as follows (DWH 2016):

- Restore lost birds by facilitating additional production and/or reduced mortality of injured bird species.
- Restore or protect habitats on which birds rely.
- Restore injured birds by species where actions would provide the greatest benefits within geographic ranges that include the Gulf of Mexico.

The project restoration objective is to create a four-acre rookery island to benefit colonial waterbirds.

1.3 Conceptual Setting

The San Antonio Bay system is an open water bay located along the central Texas coast and supports economically and ecologically significant natural resources. This large estuarine complex is one of the seven major estuaries along the Texas coast and supports the endangered whooping crane (*Grus americana*), as well as nesting colonial waterbirds and migratory/wintering waterfowl and shorebirds. The San Antonio Bay system also supports important commercial and recreational fisheries (i.e., shrimp and oysters), which depend on surrounding wetlands for maintaining water quality and providing nursery grounds for fish and shellfish (San Antonio Bay Partnership 2021).

The proposed bird rookery island would be constructed on state-owned submerged lands that are managed by the Texas General Land Office through the State School Land Board. Restoration of nesting islands and increased available food sources, such as what this project proposes, will combat ongoing sessors within the San Antonio Bay system (e.g., sea level rise, increased storm events, increased wave erosion rates, etc.) and increase available, climate resilient habitat for colonial waterbirds. Following project implementation, it is anticipated that the San Antonio Bay will be able to sustain increased nesting pairs on four acres of rookery habitat and one acre of foraging habitat. Additional information about the conceptual setting for the project is summarized in Section 3.7.3 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., lack of natural vegetation recruitment and succession). For the San Antonio Bay Bird Island project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2.0 and 3.0 summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Sea level rise	An increased local rate of sea level rise has the potential to impact restored foraging and nesting areas during high tide. Overwash may occur and flood nesting sites and/or decrease access to foraging areas.
2	Coastal acidification trends	Acidification in San Antonio Bay could result in less resilient oyster reefs with oysters that have thinner shells and slower growth rates. This could translate to less than ideal foraging and nesting areas for colonial waterbirds.
3	Catastrophic weather	Extreme weather events could damage restored islands or intertidal oyster reefs.
4	Response of target birds to the restoration techniques	Even though construction is proposed outside of the breeding season, it is possible that the colonial waterbirds do not immediately take to the restored nesting areas of the island.
5	Occurrence of forage base to support a breeding colony	Impacts due to construction may temporarily reduce the waterbird forage base, which it turn may not be able to support the increased numbers of nesting birds resulting from the restoration.
6	Success of vegetation establishment/plantings	Lack of vegetation establishment/planting success on the potentially created marsh mounds would limit or delay the creation of the desired habitat and allow for sediments to be windblown.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)	Method	Timing, Frequency, and Duration of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Protect island shoreline and restore island mass	Constructed physical infrastructure of the island.	The project site will have an as-built survey completed at the end of the project. The site will be inspected each year of the monitoring period visually and using aerial images. Results of the inspection will be compared to conditions when the project construction was completed.	Once annually during the 5-year monitoring period	The project footprint	No changes to the infrastructure footprint	Changes in the infrastructure footprint will be evaluated by the Texas TIG
Establish native vegetation for shrub nesting birds	Total vegetation cover and the species of plants present on the island.	Create a vegetation plan, collect photographs, and conduct surveys after the planting is completed.	At least one survey event every year during the monitoring period. If replanting is needed, subsequent surveys may be required following the additional replanting event.	Areas of the island where plants were transplanted and estimate survival.	A vegetation plan will be developed that will provide site specific criteria for vegetating the island, including number of plants and species.	If the survival rate of the total number of plants and the aerial coverage fall below the criteria in the vegetation plan, the Texas TIG will evaluate monitoring data and implement adaptive management actions.
Enhance the numbers of colonial nesting birds	The number of nesting pairs of birds	Conduct surveys to enumerate the number of nesting birds at the island from watercraft, aerial platforms, and photographs. Survey methodology will be consistent with methods used in the Texas Colonial Waterbird Society surveys (Damude and LeNoir 2000).	Nesting bird surveys will begin the first nesting season after construction is completed. Monitoring will occur three times each nesting season: once in April, once in May, and once in June for the 5-year monitoring period.	Observations on all nesting habitat	Increased diversity of annual nesting pairs over the performance monitoring period (5 years).	The project may require the use of artificial nesting platforms, decoys, and vocalizations to attract birds to the newly restored island.

3.0 Adaptive Management

Due to the nature of this project, and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas TIG does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Pre-Execution Monitoring Year -1	Execution Monitoring (initial) As-Built Year 0	Post-Execution Monitoring Year 1	Post-Execution Monitoring Year 2	Post-Execution Monitoring Year 3	Post-Execution Monitoring Year 4	Post-Execution Monitoring Year 5
Construction Completion Report		X					
Island Infrastructure Inspection			X	X	X	X	X
Vegetation Surveys			X	X	X	X	X
Nesting Bird Surveys		X	X	X	X	X	X

Note: X are required data acquisitions; O are optional.

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets), using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustees will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting, and archiving.

After any and all errors are addressed, data are considered to have completed a quality assurance and quality control (QA/QC) review. Before submitting the monitoring data and information package, Implementing Trustees shall confirm with one another that the package is approved for submission. The Implementing Trustees will give the other TIG members time to review the data before publication in DIVER. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

After data has been verified by QA/QC procedures, it will be stored on DIVER and, where applicable, on Implementing Trustee databases.

7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustees will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

The Texas General Land Office will be the Implementing Trustee for construction, and the U.S. Department of the Interior will be the Implementing Trustee for monitoring component of the project. Once constructed, the island would be leased to the Coastal Bend Bays and Estuaries Program for future management activities.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptive management.

11.0 References

Damude, N., and M. LeNoir. 2000. *Texas Audubon Society Colonial Waterbird Survey Training Manual*. Report to The Texas Coastal Coordination Council. NOAA Award No. NA97OZ0179.

Deepwater Horizon Oil Spill NRDA Trustees (DWH). 2016. Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement (Final PDARP/PEIS). Available at: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed November 10, 2021.

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Texas Breeding Shorebird and Seabird Stewardship Project

Version 1.0

February 2022

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 and was adapted to fit the needs of this project (DWH NRDA Trustees [DWH] 2021). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The Gulf of Mexico coastal region supports a diversity of coastal bird species throughout the year, as nesting grounds during breeding periods, as a stopover for migrating species in the spring and fall, and as wintering habitat for numerous species that breed elsewhere. The Texas Breeding Shorebird and Seabird Stewardship Project (project) would protect breeding bird habitat and reduce human disturbance to nesting shorebirds and other bird species during the nesting season along the Texas coast. Counties involved in this project would include, but may not be limited to, Galveston, Brazoria, Matagorda, Nueces, and Cameron Counties (Figure 1). This project would include 1) project team development, 2) site selection and management, and 3) implementation of stewardship activities.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) (DWH 2016). Per the Final PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Replenish and protect living coastal and marine resources
- **Restoration Type:** Birds
- **Restoration Approach(s):** Restore and conserve bird nesting and foraging habitat
- **Restoration Technique(s):** Nesting and foraging area stewardship
- **Trustee Implementation Group:** Texas TIG
- **Restoration Plan:** *Texas Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*

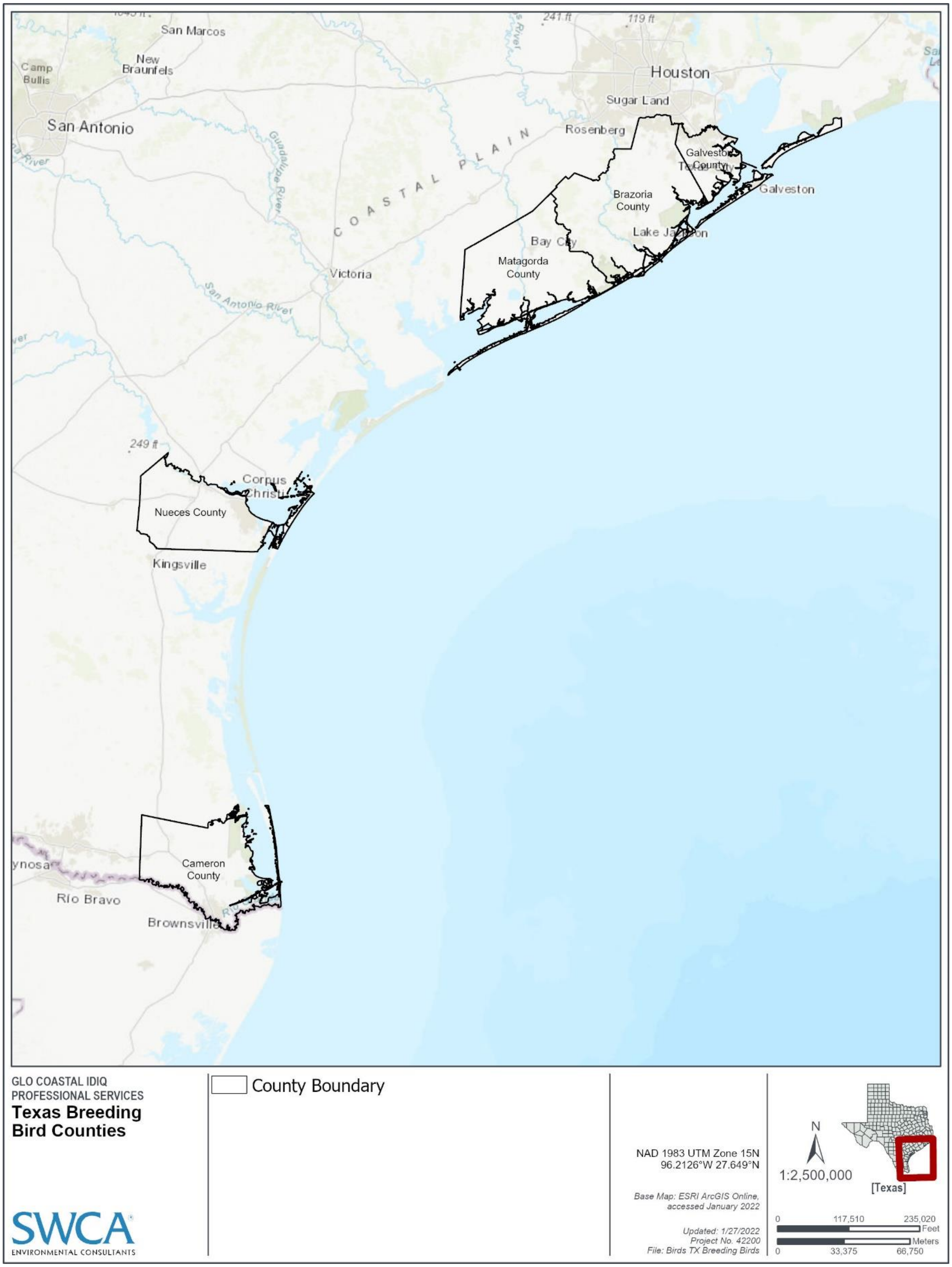

Figure 1. Project location.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to address the Bird Restoration Type. As summarized in Chapter 5 of the PDARP/PEIS (DWH 2016) and the Strategic Framework for Bird Restoration Activities (DWH 2017), the restoration goals for injuries to Birds are as follows (DWH 2016):

- Restore and Conserve Bird Nesting and Foraging Habitat through stewardship of nesting and foraging areas.
- Restore injured birds by species where actions would provide the greatest benefits within geographic ranges that include the Gulf of Mexico.

The project restoration objective is to protect bird nesting and foraging habitat through stewardship in important bird areas. Stewards will work with site managers to reduce disturbance of nesting and brooding birds, predation using exclosures, reduce incidental mortality of eggs, chicks and adults.

1.3 Conceptual Setting

The Gulf of Mexico coastal region supports a diversity of coastal bird species throughout the year, as nesting grounds during breeding periods, as a stopover for migrating species in the spring and fall, and as wintering habitat for numerous species that breed elsewhere. The Texas Breeding Shorebird and Seabird Stewardship project would protect breeding bird habitat and reduce human disturbance to nesting shorebirds and other associated bird species during the nesting season along the Texas coast. Stewardship activities would reduce the effects of disturbance and predation on nest success and enhance chick survival through the use of intervention techniques (e.g., symbolic fencing, nest patrols, etc.), which would facilitate improved nest production (i.e., more fledglings). These methods support additional recruitment into the population that would not take place otherwise (Dinsmore 2008; Foster et al. 2009). The increased recruitment would compensate for the birds lost or injured by the DWH oil spill. These intervention methods work by enhancing the production of individual birds at particular sites on an annual basis. Conditions at each site may change annually due to natural processes and/or human activities At the onset of the breeding season, birds may choose different areas to use for nesting based on these changes. Therefore, intervention methods must be seasonal, and the expected benefits would be accrued on an annual basis. Additional information about the conceptual setting for the Project is summarized in Section 3.7.4 of the RP/EA #2.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR Section 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., lack of public participation due to COVID). For the proposed Project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2.0 and 3.0 summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees used a variety of sources, including but not limited to Final PDARP/PEIS Restoration Type MAM sections (DWH 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0* (DWH 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions if the Project does not meet its performance criteria (see Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision Making
1	Ability to develop or maintain partnerships with site managers	Key to the success of this project is the support of site managers. Site managers may change over the course of the project and these activities may not be supported.
2	Targeted bird species may not be present in numbers sufficient to benefit future abundance.	Factors external to those this project would mitigate may reduce bird populations at a site. These could be floods, tropical storms, or due to wintering ground factors. If individual birds are not available or choose not to nest at the currently planned sites, the activities of the project will have no impact.
3	Lack of enforcement by site managers.	Site managers are ultimately responsible for limiting human behaviors that circumvent their rules and conditions at a particular site. Without enforcement to prevent unruly and disruptive behavior, the methods used in this project may fail.
4	Weather and climate events that limit ability to travel to or access stewardship sites. The same events can wipe out all bird nesting activity at a site.	With increased storm events and hazardous weather conditions along the coast, some stewardship activities and targeted bird species may be impacted.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance and potential corrective actions, if needed. Information on each monitoring parameter is provided below, organized by objective (Table 2). Note that Table 2 does not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 2. Project Objectives, Parameters, Data Collection Activities, Performance Criteria, and Potential Corrective Actions

Project Objective	Parameter(s)	Method	Timing, Frequency, and Duration of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Document areas of the Texas coast surveyed for target solitary and colonial nesting species	Areas surveyed	Surveys of accessible habitat sites within designated counties.	At least twice a week during the breeding season at all locations. GPS coordinates, scraps, nest status.	Total areas are surveyed (e.g., no sub-sampling)	Surveys conducted at least twice a week.	Adjust survey frequency to capture relevant events, bad weather, or meet specific needs
Document spatial extent of colonies and solitary nest locations	Estimate occupied colony or solitary nesting site location, including renests (GPS points or GIS polygons, acres)	Surveys to document colony sites and solitary nest locations	At least twice a week when and where feasible; during the nesting season.	Each respective area or site will be survey completely with subsampling.	Surveys conducted at least twice a week.	Adjust survey frequency to capture relevant events, bad weather, or meet specific needs
Collect data to assess and track reproduction metrics at each site (e.g., hatch success, chick survival, and number of chicks fledged)	Reproductive metrics	Nest site or colony site area is surveyed.	At least twice a week when and where feasible; during the nesting season.	Each solitary nest site would be tracked while colony sites may be subsampled.	An annual report providing these data for each site surveyed with maps and respective acreage provided for each site.	Survey frequency may require adjustment, breeding season may be delayed or extended, or storms may rest nesting activity.
Document disturbances to nesting sites at each project site	Disturbance type and number for each survey.	Documented by survey personnel, with photographs when possible, notes on any affected nesting birds.	Each survey event.	All sites in the project area.	An annual report providing these data for each site surveyed.	Communications with site managers to apply measures to reduce disturbance.
Deploy intervention methods such as virtual fences or engagement with public at sites	The location and shapefiles for virtually fenced areas.	Use of twine, wooden or metal posts, and signs to alert the public of nesting birds.	Polygons as ESRI shapefiles or Google Earth kmz files when used. Dependent on site manager's permission.	TBD	Virtual fences are not broken or bypassed by the public.	Site managers may wish to deploy more effective methods based on human behaviors at their site.
Perform outreach at public events conditional with Covid status	Number of public participants that were engaged at each event.	Coordinating with site managers regarding public events and obtaining a station or booth.	TBD based on Covid	NA	An annual report providing these data for each site the events took place.	

Project Objective	Parameter(s)	Method	Timing, Frequency, and Duration of Data Collection	Sample Size/Sites	Performance Criteria	Potential Corrective Actions
Coordinate and communicate findings with land mangers	Site manager engagement	Direct communication and through reports	Prior to the onset of breeding season, during the breeding season and a post-season briefing.	NA	Documented in annual reports	Site managers may use information to revise their public use plans, their locations, and timing of those events.
Banding adult and chick plovers under minimal risk conditions.	Number of adults and chicks banded per survey site.	May vary but banding methods are approved by USFWS, USGS, and state wildlife agency	Opportunity dependent	NA	Number of birds, age, band numbers, per site.	Conditions that may pose unnecessary risks to the birds would be avoided.

3.0 Adaptive Management

Due to the nature of this project, and the use of standard restoration techniques that have been successfully implemented in similar projects, the Texas TIG does not anticipate the need for rigorous adaptive management of the project. If project objectives are not being met, the Texas TIG would identify corrective actions as necessary.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Evaluations of MAM data are used to 1) determine whether the project, once implemented, has met its objectives, and 2) inform the need for potential corrective actions (see Table 2).

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 3 by monitoring parameter.

Table 3. Monitoring Schedule

Monitoring Parameters	Post-Execution Monitoring Year 1	Post-Execution Monitoring Year 2	Post-Execution Monitoring Year 3	Post-Execution Monitoring Year 4	Post-Execution Monitoring Year 5
Stewardship activities developed	X	X	X	X	X
Education and outreach effort	X	X	X	X	X
Bird abundance, density, or occupancy	X	X	X	X	X
Bird nesting success, survival, and production	X	X	X	X	X

Note: X are required data acquisitions; O are optional.

7.0 Data Management

To the extent practicable, after consideration of ongoing federal and/or state-specific efforts (e.g., current protocols, existing databases), all environmental and biological data generated during monitoring activities will be documented using a standardized format (e.g., field datasheets) using the data parameters listed above. Data may be collected, tabulated, and/or reported using a variety of available tools, both electronic and non-electronic. Electronic data file names should include the date on which the file was created, a ReadMe file that describes when and by whom the file was created, and any explanatory notes about the file contents. If a data file is revised, a new copy will be made and the original preserved. The Implementing Trustee will verify and validate monitoring data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

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A standardized reporting format will be developed to the extent practicable (e.g., from standardized data sheet). Prior to publication, data will be reviewed and verified for completeness. A quality check is done by comparing the entered electronic data to the original hard copy data sheet. Data are validated and any necessary corrections are made. Upon validation, data are approved for analysis, reporting and archiving.

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7.3 Data Sharing

Data will be made publicly available through DIVER and, where applicable, Implementing Trustee databases, in accordance with the applicable data sharing policies and regulations in operation at the time of data collection.

8.0 Reporting

Project monitoring information will be prepared and uploaded to DIVER annually. The Implementing Trustee will develop a final, high-level summary report prior to project closeout.

9.0 Roles and Responsibilities

The Department of the Interior (DOI) will be the Implementing Trustee and will coordinate with the Texas TIG and the Regionwide (RW) TIG, along with potential project partners, to implement proposed activities.

10.0 Monitoring and Adaptive Management Budget

The budget for this project includes support for the full range of monitoring and adaptive management activities described above, including field sampling, data management, report writing, and adaptive management.

11.0 References

Deepwater Horizon Oil Spill NRDA Trustees (DWH). 2016. *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS). Available at: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed November 10, 2021.

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Dinsmore, S.J. 2008. Black skimmer nest survival in Mississippi. *Waterbirds* 31(1):24–29.

Foster, C.R., A.F. Amos, and L.A. Fuiman. 2009. Trends in abundance of coastal birds and human activity on a Texas barrier island over three decades. *Estuaries and Coasts* 32(6):1079–1089.

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APPENDIX B

Best Management Practices

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The best management practices (BMPs) presented in this appendix could be implemented to minimize or avoid potential impacts to resources during implementation of activities or postconstruction for alternatives under consideration in the *Texas Trustee Implementation Group Draft RP/EA #2: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; Oysters; Sea Turtles; and Birds*.

Geology And Substrates

Specific measures would be implemented during construction to minimize erosion and overall soil impacts. To the extent possible, the alternatives would use the existing development footprints and disturbed areas (e.g., parking areas). These would include following established BMPs for construction activities such as the implementation of an erosion control and stormwater management plan, the installation of sediment traps prior to commencement of construction activities, and ongoing construction monitoring to ensure compliance. In-water work, such as construction marshes, oyster reefs or breakwaters, would be performed behind silt curtains to isolate construction impacts.

Hydrology And Water Quality

Pollution prevention plans would be prepared as necessary, in conjunction with the National Pollutant Discharge Elimination System (NPDES) permitting process prior to construction. These plans would include all specifications and BMPs necessary for control of erosion and sedimentation due to construction-related activities. The construction BMPs, in addition to other avoidance and mitigation measures as required by state and federal regulatory agencies, would minimize water quality and hydrology impacts.

Air Quality

Emission-reduction measures to mitigate for short-term air quality impacts could include using ultra-low-sulfur diesel fuel in off-road construction equipment, limiting unnecessary idling time of diesel-powered engines, controlling dust related to construction site activities, and covering trucks hauling loose materials.

Noise

BMPs that serve to limit noise impacts to humans from construction activities include the following:

- Limiting activity at alternatives to daytime hours
- Limiting truck traffic ingress/egress to the site to daytime hours
- Promoting awareness that producing prominent discrete tones and periodic noises (e.g., excessive dump truck gate banging) should be avoided as much as possible
- Requiring that work crews seek pre-approval for any weekend activities or activities outside of daytime hours
- Timing of in-water noise-producing activities to minimize disturbances to marine life
- Implementing standard practices, such as muffle units for generators, during construction operations to mitigate noise impacts

Aquatic Resources

BMPs that serve to mitigate impacts to aquatic fauna, essential fish habitat, and managed include the following:

- Signage, fencing, or landscaping is used to focus foot and boat traffic to certain areas, as practicable, thereby limiting shoreline and nearshore disturbances.
- BMPs during construction would likely include time-of-year restrictions for any in-water work to avoid and minimize impacts to protected and managed species when they are expected to be present or when most vulnerable.
- BMPs during construction would also likely include standard erosion and sediment control measures (e.g., silt fence) to protect water quality and aquatic habitats from impacts resulting from construction stormwater and sediment runoff. Project design standards could include no net increase in stormwater runoff and associated pollutants.
- Unavoidable impacts to jurisdictional wetlands and waters would be mitigated, if necessary.
- EFH consultation guidance documents on the NMFS webpage may provide additional BMPs to avoid or limit alternative impacts to EFH.

Cultural Resources

Measures that serve to mitigate impacts to cultural resources include the following:

- Cultural and historic resources would be considered when preparing site-specific restoration measures and management actions.
- Where there is a likelihood of disturbance of cultural resources, cultural resource managers would conduct appropriate surveys to assess the methods and location of restoration and management actions.
- Restoration measures and management actions would be designed to avoid cultural resources to the extent practicable.

Infrastructure

Measures that serve to mitigate impacts to general infrastructure include the following:

- Erosion- and sedimentation-control measures, including minimizing the amount of clearing and exposed soil, would be implemented and maintained.
- Sedimentation controls would be installed prior to the start of construction and maintained throughout the construction period.
- Disturbed areas would be revegetated with native species as soon as possible after work has been completed.

Measures that serve to mitigate impacts to pipeline infrastructure include the following:

- The Contractor will notify all utility operators and pipeline companies at least 72 hours in advance of any work at the restoration area and at least four weeks in advance of any work within/crossing the conveyance corridors.

- All pipelines located within 150 feet of the containment dike alignment, borrow channel alignment, access channels, rock revetment alignments, and beach/dune and marsh fill areas and any pipelines crossing the conveyance corridors will be probed by the Contractor for depth and their locations marked prior to excavation, dredging, and installation of the sediment pipeline, for the duration of construction activities in accordance with technical specifications.
- No excavation shall be permitted within 50 feet of any pipeline in the vicinity of the containment dike alignment, borrow channel alignment, access channels, rock revetment alignments, and beach/dune and marsh fill areas.
- The Contractor shall notify all pipeline companies or current pipeline right-of-way permit holders near the borrow areas, containment borrow channel, and access channels at least four weeks in advance of any dredging or excavation so that the pipeline companies or right-of-way permit holders may take precautions to mark its pipeline segments if they choose to do so.
- No dredging or bottom disturbing activities (including anchoring or spudding) may take place within 500 feet of any existing pipeline near borrow areas.
- Any anchoring within the allowable anchor areas near pipeline crossings shall be in accordance with the oil/gas pipeline owner crossing agreements obtained by the Contractor. If no anchoring restrictions are defined in the crossing agreement for a particular pipeline crossing a conveyance corridor, then no anchoring shall be allowed within 250 feet of said pipeline.
- All equipment operation within the Restoration Area shall maintain at all times a minimum of 10 feet of clearance from the top of the equipment and the overhead electrical transmission lines. If for any reason the Contractor feels that this requirement cannot be met, then all equipment shall remain a minimum of 100 feet horizontally from the overhead electrical transmission lines and the Contractor should immediately notify the owner and engineer.

Public Health and Safety

Measures that serve to mitigate impacts to public health and safety include the following:

- Caution would be taken to prevent spills of oils and grease if handling fuels on-site.
- Spill mitigation measures would be employed immediately following a spill of any hazardous material.
- The load compartments of trucks hauling dust-generating materials would be covered.
- Heavy water spray or chemical dust suppressant would be used in exposed areas to control airborne dust.
- Any produced waters or human waste would not be discharged unless the Department of Health and Hospitals requirements are met or exceeded.
- Flood access and evacuation plans would be filed on-site.

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APPENDIX C

Reasonably Foreseeable Project List

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Action	Description	RP/EA #2 Restoration Type(s)

Oyster reef creation, enhancement, or restoration	Reasonably foreseeable projects and programs to create or restore oyster reefs along the Texas coast include, but are not limited to:
	• Projects in the 2019 *Texas Coastal Resiliency Master Plan*
	  ○ Half Moon Oyster Reef Restoration- Phase 3
	  ○ Oliver Point Oyster Reef Restoration
	• Projects in the *Coastal Texas Protection and Ecosystem Restoration Feasibility Study*
	  ○ Bolivar Peninsula and West Bay Gulf Intracoastal Waterway (GIWW) Shoreline and Island Protection
	  ○ West Bay and Brazoria GIWW Shoreline Protection
	  ○ East Matagorda Bay Shoreline Protection
	  ○ Keller Bay Restoration
	  ○ Redfish Bay Protection and Enhancement
	• Oyster Restoration Engineering Project
	• Improving Resilience for Oysters by Linking Brood Reefs and Sink Reefs (Large-scale), Component 1: East Galveston Bay, TX
		Oysters, Birds

Resource Stewardship: Sea Turtle Restoration	Reasonably foreseeable projects and programs to protect sea turtles along the Texas coast include, but are not limited to: • Reducing Marine Debris Impacts on Birds and Sea Turtles • Regionwide Enhancements to the Sea Turtle Stranding and Salvage Network and Enhanced Rehabilitation • Restore and Enhance Sea Turtle Nest Productivity • Reducing Sea Turtle Bycatch at Recreational Fishing Sites • Sea Turtle Early Restoration Project	Sea Turtle
Resource Stewardship: Birds Restoration	Reasonably foreseeable projects and programs to protect birds and their habitat along the Texas coast include, but are not limited to: • Reducing Marine Debris Impacts on Birds and Sea Turtles • Conservation and Enhancement of Nesting and Foraging Habitat for Birds, Component 3: San Antonio Bay Bird Island, TX • Texas Rookery Islands	Oysters, Birds

Action	Description	RP/EA #2 Restoration Type(s)
Resource Stewardship: Wetlands, Coastal, and Nearshore Habitats Restoration	Reasonably foreseeable projects and programs to restore or protect wetlands, coastal, and nearshore habitats along the Texas coast include, but are not limited to: • Essex Bayou Habitat Restoration Engineering • Dredged Material Planning for Wetland Restoration • McFaddin Beach and Dune Restoration • Bessie Heights Wetland Restoration • Pierce Marsh Wetland Restoration • Bahia Grande Hydrologic Restoration • Projects in the *Coastal Texas Protection and Ecosystem Restoration Study* ○ Bolivar Peninsula and West Bay GIWW Shoreline and Island Protection ○ West Bay and Brazoria GIWW Shoreline Protection ○ Keller Bay Restoration ○ Powderhorn Shoreline Protection and Wetland Restoration ○ East Matagorda Bay Shoreline Protection ○ Tern Island and Triangle Tree Island Rookery Habitat Protection ○ Follets Island Gulf Beach and Dune Restoration ○ Redfish Bay Protection and Enhancement ○ Port Mansfield Channel, Island Rookery, Hydrologic Restoration • Projects in the Texas Coastal Resiliency Master Plan ○ Indian Point Marsh Area Living Shoreline ○ Willow Lake Shoreline Stabilization ○ Dollar Bay Wetland Creation, Restoration, and Acquisition ○ Mad Island Shoreline Protection and Ecosystem Restoration ○ Goose Island State Park Habitat Restoration and Protection ○ Aransas National Wildlife Refuge Dagger Point Shoreline Preservation ○ Little Bay Restoration Initiative ○ Port Aransas Nature Preserve Stabilization and Restoration	Oysters, Birds, Wetlands, Coastal, and Nearshore Habitats
Resource Stewardship: Land acquisition	Reasonably foreseeable projects for land acquisition along the Texas coast include, but are not limited to: • Projects in the *Texas Coastal Resiliency Master Plan* ○ Dollar Bay Wetland Creation, Restoration and Acquisition ○ Follet's Island Conservation Initiative ○ East and West Galveston Bay Watershed, Wetland and Habitat Conservation ○ South Padre Island Coastal Beach Protection ○ South Padre Island Park Development • Follets Island Habitat Acquisition	Birds, Wetlands, Coastal, and Nearshore Habitats

APPENDIX D

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APPENDIX E

U.S. Department of Agriculture Conservation Practices

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Code	Practice
201	Edge of Field Water Quality Monitoring Data Collection
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441	Irrigation System, Microirrigation
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490	Forest Site Preparation (Chemical or Burning)
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511	Forage Harvest Management
512	Pasture and Hay Planting
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554	Drainage Water Management
561	Heavy Use Area Protection
576	Livestock Shelter Structure

578	Stream Crossing
580	Streambank and Shoreline Protection
587	Structure For Water Control
590	Nutrient Management
595	Pest Management
600	Terrace
612	Tree/Shrub Establishment (Hand Planting)
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642	Water Well
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666	Forest Stand Improvement (Chemical/Hand Tools)
666	Forest Stand Improvement (Cutting/removal with heavy equipment)

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

RESIDUE AND TILLAGE MANAGEMENT, NO TILL

CODE 329

(ac)

DEFINITION

Limiting soil disturbance to manage the amount, orientation, and distribution of crop and plant residue on the soil surface year around.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce sheet, rill and wind erosion, and excessive sediment in surface waters.
- Reduce tillage-induced particulate emissions.
- Maintain or increase soil health and organic matter content.
- Increase plant-available moisture.
- Reduce energy use.
- Provide food and escape cover for wildlife.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all cropland.

CRITERIA

General Criteria Applicable to All Purposes

Residue shall not be burned.

No haying or grazing of crop residue is allowed.

Distribute all residues uniformly over the entire field. Removing residue from directly within the seeding or transplanting area prior to or as part of the planting operation is acceptable.

This practice **only** involves an in-row soil disturbance operation during strip tillage, the planting operation, and a seed row/furrow closing device. There is **no full-width soil disturbance performed** from the time immediately following harvest or termination of one cash crop through harvest or termination of the next cash crop in the rotation regardless of the depth of the tillage operation. The soil tillage intensity rating (STIR) value shall include all field operations that are performed during the crop interval between harvest and termination of the previous cash crop and harvest or termination of the current cash crop (includes fallow periods). The crop interval STIR value shall be no greater than 20.

This practice includes planting methods commonly referred to as no till, never till, zero till, slot plant, zone till, strip till, or direct seed. Approved implements are: no till and strip till planters, certain drills and air seeders, strip-type fertilizer and manure injectors and applicators, and similar implements that only disturb narrow strips and slots.

The soil tillage intensity rating (STIR) value shall include all field operations that are performed during the crop interval between harvest and termination of the previous cash crop and harvest or termination of the current cash crop (includes fallow periods). The crop interval STIR value shall be no greater than 20.

Grazeout small grains or forage sorghums (i.e., not harvested for grain) will only be applied once within a crop rotation and at a rate of no more than one in three years. The grazed out crop shall maintain 60% ground cover of living biomass and will be immediately followed by the planting of a high residue producing warm season crop or cover crop to supply crop residue which is lost during the grazing operation.

When ruts created from normal field operations (harvest, irrigation, etc.) become a concern, leveling shall be limited to implements that minimize residue burial (ex. Sweeps, chisels, etc.) whenever possible. Tillage will only be used on the area(s) of the field needing to be leveled. Soil disturbance shall be limited to no more than 10% of the field acres. Avoid tillage when soil is wet.

Additional Criteria to Reduce Sheet, Rill and Wind Erosion, Reduce Excessive Sediment in Surface Waters, and Reduce Tillage-Induced Particulate Emissions

Use the current approved water and wind erosion prediction technology to determine if the field operations planned provide the following:

- Amount of randomly distributed surface residue needed.
- Time of year residue needs to be present in the field.
- Amount of surface soil disturbance allowed to reduce erosion to the desired level.
- Calculations shall account for the effects of other practices in the management system.

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Ensure the soil condition index (SCI) for the cropping system results in a positive rating. The SCI results have to be a positive value.

Additional Criteria to Increase Plant-Available Moisture

Maintain all residue cover on the soil surface throughout the year.

Crop stubble height during time of expected evaporation losses shall be:

- At least 10 inches for crops with a row spacing of less than 15 inches.
- At least 15 inches for crops with a row spacing of 15 inches or greater.

  These stubble heights shall be present on at least 60% of the field.

Additional Criteria to Reduce Energy Use

Reduce the total energy consumption associated with field operations by at least 25 percent compared to the benchmark condition. Use the current approved NRCS tool for determining energy use to document energy use reductions.

Additional Criteria to Provide Food and Escape Cover for Wildlife

Use an approved habitat evaluation procedure to determine when residue needs to be present, and the amount, orientation, and stubble height needed to provide adequate food and cover for target species.

CONSIDERATIONS

General Considerations

These activities should not be performed without full evaluation of impacts on soil, water, animal, plant, and air resources. Effects on soil erosion and soil conditioning index (SCI) will be evaluated with the current approved erosion prediction technology.

Production of adequate crop residues to achieve the purpose(s) of this practice can be enhanced through the use of high residue crops and crop varieties, use of cover crops, double cropping, and adjustment of plant populations through seeding rates and row spacing.

When providing technical assistance to organic producers, ensure residue and tillage management, activities are consistent with the USDA Agricultural Marketing Service National Organic Program regulations.

Residue should not be shredded after harvest. Shredding residue makes it more susceptible to movement by wind or water, and areas where residue accumulates may interfere with planting the next crop.

Using wider spacing on drills will disturb less soil and leave more standing residue thus more protection against wind and water erosion.

Using residue management - no till for all crops in the rotation or cropping system can enhance the positive effects of this practice by—

- Increasing the rate of soil organic matter accumulation.
- Keeping soil in a consolidated condition and improved aggregate stability.
- Sequestering additional carbon in the soil.
- Further reducing the amount of particulate matter generated by field operations.
- Reduce energy inputs to establish crops.
- Forming root channels and other near-surface voids that increase infiltration.

Considerations to Increase Soil Health and Organic Matter Content

Carbon loss is directly related to the volume of soil disturbed, intensity of the disturbance and soil moisture content and soil temperature at the time the disturbance occurs. To make this practice more effective—

- When deep soil disturbance is performed, such as by subsoiling or fertilizer injection, make sure the vertical slot created by these implements is closed at the surface.
- Planting with a single disk or slot opener no-till drill will release less CO_2 and oxidize less organic matter than planting with a wide-point hoe/chisel opener seeder drill.
- Soil disturbance that occurs when soil temperatures are below 50 °F will oxidize less organic matter and release less CO_2 than operations done when the soil is warmer.
- Maximizing year-round coverage of the soil with living vegetation (e.g., cover crops) and crop residues, if applicable, builds organic matter and reduces soil temperature, thereby slowing organic matter oxidation.
- Use a diverse crop rotation, incorporating multiple crop types (cool-season grass, cool-season legume/forb, warm-season grass, warm-season legume/forb) into the crop rotation.
- Plant a cover crop after every cash crop in the rotation. Multispecies cover crop mixes provide greater benefits than single-specie cover crops.

Considerations to Increase Plant-Available Moisture

Leaving stubble taller than the 10-inch minimum will trap more snow.

Cover crop residue will help retain soil moisture and is another effective agronomic management tool.

Soil-disturbing operations performed when the soil surface is moist will result in greater moisture loss than operations done when the top two or three inches of soil have dried.

Leaving stubble taller than the minimum required will increase the relative humidity close to the soil surface, which reduces the rate of evaporative loss from the soil.

Variable-height stubble patterns may be created to further increase snow storage.

Performing all field operations on the contour will slow overland flow and allow more opportunity for infiltration.

Considerations for Wildlife Food and Cover

Leaving rows of unharvested crop standing at intervals across the field or adjacent to permanent cover will enhance the value of residues for wildlife food and cover. Leaving unharvested crop rows for two growing seasons will further enhance the value of these areas for wildlife.

Leave crop residues undisturbed after harvest (e.g., no shredding or baling) to maximize the cover and food source benefits for wildlife. Avoid disturbing standing stubble or heavy residue during the nesting season for ground nesting species.

Conservation buffers, planting corners to wildlife and pollinator seed mixes would benefit wildlife, beneficial insects, and insect pollinator species. Timing of pesticide applications and turning off pesticide applicator booms in these areas will help protect beneficial insects and pollinators.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit. Record the specifications using the practice implementation requirements document. The specifications shall identify, as appropriate—

- Purpose for applying the practice or resource concern to be treated.
- Planned crops.
- Amount of residue produced by each crop.
- All field operations or activities that affect the—
  - Residue orientation including height (where applicable).
  - Surface disturbance.
  - Amount of residue (pounds/acre or percent surface cover) required to accomplish the purpose, and the time of year it must be present.
- Planned soil tillage intensity rating STIR value, soil condition index value, and erosion rate.
- Grazing Plan if applicable.
- Target species of wildlife, if applicable.
- Benchmark and planned fuel consumption, if applicable.

Record the specifications using the Texas Code 329 Practice Implementation Requirements document located in eFOTG Section IV – Conservation practices – Residue and Tillage Management – No Till (329 Code) folder. Locate the folder from the below link:

eFOTG-Document Locator

OPERATION AND MAINTENANCE

Evaluate/measure the crop residues cover and orientation after each crop to ensure the planned amounts and orientation are being achieved. Adjust management as needed to either plan a new residue amount and orientation or adjust the planting equipment, and if applicable, the harvesting equipment.

Limited tillage is allowed to close or level ruts from harvesting equipment. No more than 10 percent of the field may be tilled for this purpose.

If there are areas of heavy residue accumulation (because of movement by water or wind) in the field, spread the residue prior to planting so it does not interfere with planter operation.

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Effects of NRCS Conservation Practices - National

Residue and Tillage Management, No Till/Strip Till/Direct Seed

Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round, limiting soil-disturbing activities to those necessary to place nutrients, condition residue and plant crops.

Code: 329
Units: ac.

	C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
Typical Landuse:	C			P					O	

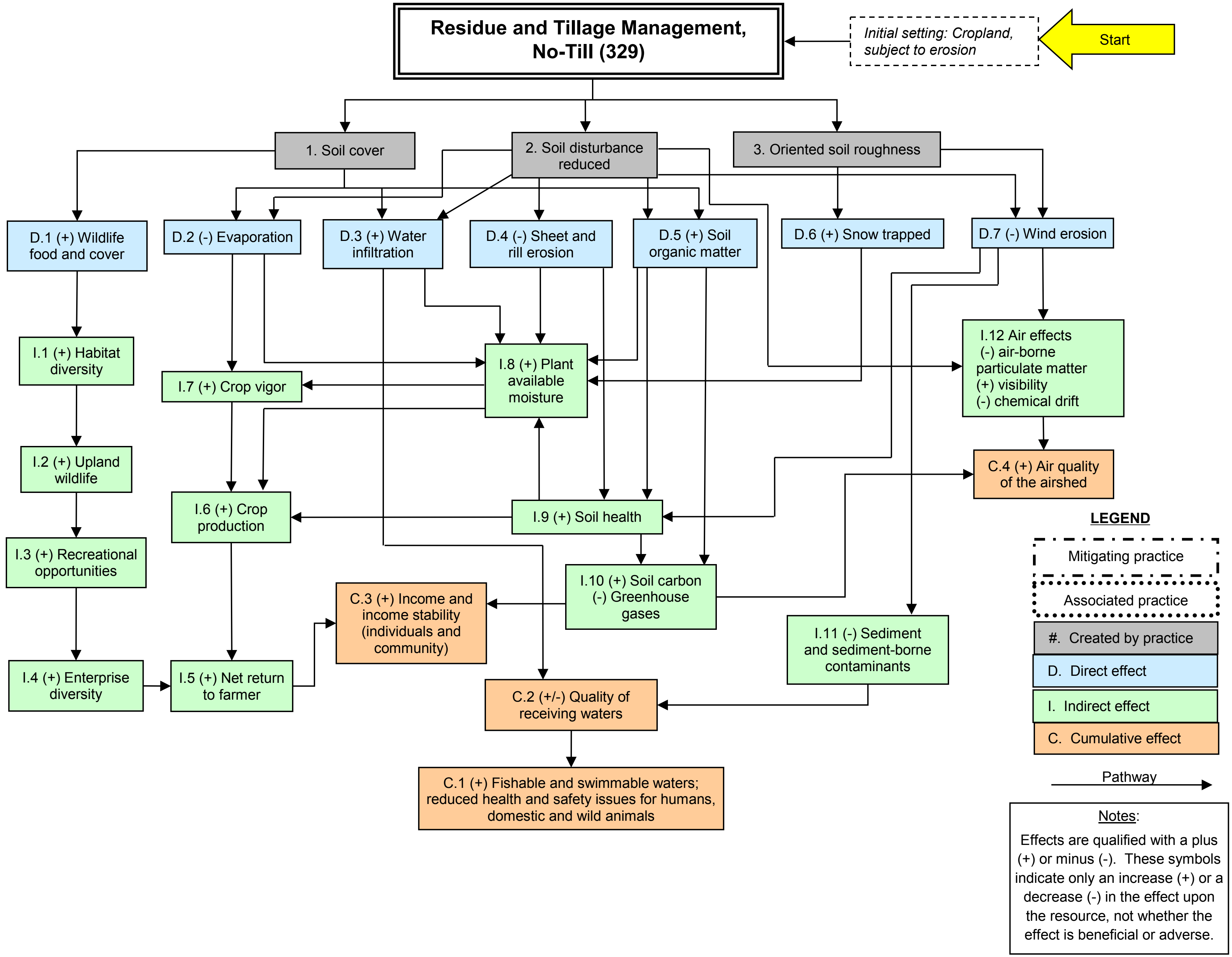
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	4	Managing residue to reduce soil disturbance and increase residue cover reduces erosion by water.
Soil Erosion - Wind Erosion	4	Managing residue to reduce soil disturbance and increase residue cover reduces erosion by wind.
Soil Erosion - Ephemeral Gully Erosion	4	Managing residue to reduce soil disturbance and increase residue cover reduces erosion by water.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	Decreased erosion and less oxidation from lack of soil disturbance will increase or maintain organic matter.
Compaction	2	Fewer field operations and less tillage reduce the potential for soil compaction.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	1	Low disturbance and high residue cropping systems increase organic matter which will buffer salts.
Excess Water		
Excess Water - Seeps	-1	No-till increases infiltration resulting in more water moving through the profile.
Excess Water - Runoff, Flooding, or Ponding	2	No-till increases infiltration, reducing runoff and ponding.
Excess Water - Seasonal High Water Table	-1	Can reduce evaporation and increase infiltration of water
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	2	No-till increases infiltration and decreases evaporation resulting in more available water. However, increased infiltration reduces the efficiency of flood and furrow irrigation.
Insufficient Water - Inefficient Moisture Management	2	No-till increases infiltration and decreases evaporation resulting in more available water.
Water Quality Degradation		
Pesticides in Surface Water	4	The action decreases runoff and erosion.
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	2	Less erosion and runoff reduces transport of nutrients.
Nutrients in Groundwater	-1	The action increases infiltration that contributes to nutrient leaching. Also, high organic carbon will cause microbes to immobilize nutrients.
Salts in Surface Water	1	Less runoff reduces transport of soluble salts. However increased infiltration results in more seepage which can carry soluble salts to the surface.
Salts in Groundwater	-1	Better infiltration may increase leaching potential.
Excess Pathogens and Chemicals from Manure, Bio-solid	1	Less erosion and runoff reduces delivery of pathogens.
Excess Pathogens and Chemicals from Manure, Bio-solid	0	Not Applicable

Excessive Sediment in Surface Water	4	Less erosion and runoff reduces transport of sediment.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	4	Less soil disturbance, increased residue on the surface and fewer field operations reduce the generation of particulate matter.
Emissions of Ozone Precursors	2	Reduced use of machinery reduces ozone precursor emissions.
Emissions of Greenhouse Gases (GHGs)	4	Reduced use of machinery reduces CO_2 emissions and increases soil carbon storage.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Conserving moisture and improving soil conditions contribute to enhanced plant productivity and health. However, on cold and wet soils there may be a delay in emergence and early growth.
Inadequate Structure and Composition	0	Not Applicable
Excessive Plant Pest Pressure	0	Not Applicable
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Crop residue provides some food for wildlife.
Inadequate Habitat - Cover/Shelter	2	Crop residue provides some cover/shelter.
Inadequate Habitat - Water	4	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	1	Residue restores some habitat/space.
Livestock Production Limitation		
Inadequate Feed and Forage	0	Not Applicable
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	4	No tillage equipment needed
Farming/Ranching Practices and Field Operations	4	No tillage operations

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2016



United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

COVER CROP

CODE 340

(ac)

DEFINITION

Grasses, legumes, and forbs planted for seasonal vegetative cover.

PURPOSE

This practice is applied to support one or more of the following purposes:

- Reduce erosion from wind and water
- Maintain or increase soil health and organic matter content
- Reduce water quality degradation by utilizing excessive soil nutrients
- Suppress excessive weed pressures and break pest cycles
- Improve soil moisture use efficiency
- Minimize soil compaction

CONDITIONS WHERE PRACTICE APPLIES

All lands requiring seasonal vegetative cover for natural resource protection or improvement.

CRITERIA

General Criteria Applicable to All Purposes

Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with applicable local criteria and soil/site conditions.

Refer to TX Cover Crop Calculator in the Texas FOTG: – NRCS Field Office Technical Guide

Use the TX Cover Crop Calculator for planning and certifying Cover Crop (Code 340) whether used for a cover crop or dead litter cover.

Select species that are compatible with other components of the cropping system.

Annual, biennial, or perennial cover crops species not listed in the TX Cover Crop Calculator can be no more than 10% of the total cover crop mix. Any weed species listed on the seed tag cannot be counted toward the 10% of the seeding mix. Also, no species listed as part of Texas Department of Agriculture, Texas Noxious and Invasive Plants list.

Ensure herbicides used with crops are compatible with cover crop selections and purpose(s).

Cover crops may be established between successive production crops, or companion-planted or relay-planted into production crops. Select species and planting dates that will not compete with the production crop yield or harvest.

Do not burn cover crop residue.

Determine the method and timing of termination to meet the grower's objective and the current NRCS Cover Crop Termination Guidelines. Cover crops should not be terminated before meeting the intended resource concern objective.

When a cover crop will be grazed ensure that crop selection(s) comply with pesticide label rotational crop restrictions and that the planned management will not compromise the selected conservation purpose(s).

Deadlitter cover crops shall not be grazed. Do not harvest cover crops.

If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Regardless of who grows or sells the seed, a copy of the current (within nine months) analysis must be provided. This test is valid for nine months after the end of the month the test was made, so long as the seed remains in Texas. (Note: The state law pertains to the sale, offer for sale, expose for sale or transport for sale of any agricultural seed within Texas.) Seed purchased outside of Texas must comply with all federal seed laws.

All seed and planting materials shall meet state quality standards. Rules and statutes pertaining to seed quality in Texas can be found in Chapters 9, 10, 61, 62, and 64 of the Texas Agricultural Code. Refer to Texas Department of Agriculture website at www.agr.state.tx.us under the Laws/Regulations Section."

Additional Criteria to Reduce Erosion from Wind and Water

Time the cover crop establishment in conjunction with other practices to adequately protect the soil during the critical erosion period(s).

Select cover crops that will have the physical characteristics necessary to provide adequate erosion protection.

Use the current erosion prediction technology to determine the amount of surface and/or canopy cover needed from the cover crop to achieve the erosion objective.

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Cover crop species will be selected on the basis of producing higher volumes of organic material and root mass to maintain or increase soil organic matter.

The planned crop rotation including the cover crop and associated management activities will score a Soil Conditioning Index (SCI) value > 0, as determined using the current approved NRCS Soil Conditioning Index (SCI) procedure, with appropriate adjustments for additions to and or subtractions from plant biomass.

If a multi species cover crop is being planned using soil health and organic matter as a resource concern in the cropland landuse, then a conservation crop rotation using high residue crops and reduced tillage conservation practices are recommended as a suite of practices to meet this practice purpose. The practices coinciding with cover crops include Conservation Crop Rotation (Code 328), Residue Management No-Till/Strip Till (Code 329), and/or Residue and Tillage Management Reduced Till (Code 345).

At least one high residue crop for harvest or a high biomass cover crop must be in the rotation. See high residue and low residue crop tables in Cover Crop Specification. This helps keep the soil covered and promotes plant diversity.

This will support the soil health principles.

- Minimize soil disturbance

- Maximize soil cover
- Maximize biodiversity
- Maximize presence of living roots

The cover crop shall be planted as early as possible and be terminated as late as practical for the producer's cropping system to maximize plant biomass production, considering crop insurance criteria, the time needed to prepare the field for planting the next crop, and soil moisture depletion.

<u>Additional Criteria to Reduce Water Quality Degradation by Utilizing Excessive Soil Nutrients</u>

Establish cover crops as soon as practical prior to or after harvest of the production crop. (i.e. before or after harvest)

Select cover crop species for their ability to effectively utilize nutrients.

Terminate the cover crop as late as practical to maximize plant biomass production and nutrient uptake. Practical considerations for termination date may include crop insurance criteria, the amount of time needed to prepare the field for planting the next crop, weather conditions, and cover crop effects on soil moisture and nutrient availability to the following crop.

<u>Additional Criteria to Suppress Excessive Weed Pressures and Break Pest Cycles</u>

Select cover crop species for their life cycles, growth habits, and other biological, chemical and or physical characteristics to provide one or more of the following:

- To suppress weeds, or compete with weeds.
- Break pest life cycles or suppress of plant pests or pathogens.
- Provide food or habitat for natural enemies of pests.
- Release compounds such as glucosinolates that suppress soil borne pathogens or pests.

Select cover crop species that do not harbor pests or diseases of subsequent crops in the rotation.

<u>Additional Criteria to Improve Soil Moisture Use Efficiency</u>

In areas of limited soil moisture, terminate growth of the cover crop sufficiently early to conserve soil moisture for the subsequent crop. Cover crops established for moisture conservation shall be left on the soil surface.

In areas of potential excess soil moisture, allow the cover crop to grow as long as possible to maximize soil moisture removal.

<u>Additional Criteria to Minimize Soil Compaction</u>

Select cover crop species that have the ability to root deeply and the capacity to penetrate or prevent compacted layers.

CONSIDERATIONS

<u>General Considerations</u>

Plant cover crops in a timely matter and when there is adequate moisture to establish a good stand.

When applicable, ensure cover crops are managed and are compatible with the client's crop insurance criteria.

Maintain an actively growing cover crop as late as feasible to maximize plant growth, allowing time to prepare the field for the next crop and to optimize soil moisture.

Select cover crops that are compatible with the production system, well adapted to the region's climate and soils, and resistant to prevalent pests, weeds, and diseases. Avoid cover crop species that harbor or carry over potentially damaging diseases or insects.

Cover crops may be used to improve site conditions for establishment of perennial species.

Soil testing is recommended prior planting cover crop to identify soil conditions that would affect the growth potential and specie selection. Select the adapted specie for the site condition or correct the soil condition. i.e. soil pH, low fertility levels.

If livestock integration is planned or utilized for forage, select species that will have desired forage traits, be palatable to livestock, and not interfere with the production of the subsequent crop.

Use plant species that enhance forage opportunities for pollinators by using diverse legumes and other forbs.

Cover crops may be selected to provide food or habitat for natural enemies of production crop pests.

Cover crops residues should be left on the soil surface to maximize allelopathic (chemical) and mulching (physical) effects.

Seed a higher density cover crop stand to promote rapid canopy closure and greater weed suppression. Increased seeding rates (1.5 to 2 times normal) can improve weed-competitiveness.

Cover crops may be selected that release biofumigation compounds that inhibit soil-borne plant pests and pathogens.

Species can be selected to serve as trap crops to divert pests from production crops.

Select a mixture of two or more cover crop species from different plant families to achieve one or more of the following: (1) species mix with different maturity dates, (2) attract beneficial insects, (3) attract pollinators, (4) increase soil biological diversity, (5) serve as a trap crop for insect pests, or (6) provide food and cover for wildlife habitat management.

Ensure that soil pH conditions are appropriate for successful legume establishment by soil testing. Legume seedlings are particularly sensitive to acidic soil conditions. Acid soils also reduce rhizobia colonization at legume roots, nodulation, and nitrogen fixation. Clients should apply lime to address pH conditions of 5.5 or lower before seeding legumes.

Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to achieve biological nitrogen fixation. Select cover crop species or mixture, and timing and method of termination that will maximize efficiency of nitrogen utilization by the following crop, considering soil type and conditions, season and weather conditions, cropping system, C:N ratio of the cover crop at termination, and anticipated nitrogen needs of the subsequent crop. Use LGU- recommended nitrogen credits from the legume and reduce nitrogen applications to the subsequent crop accordingly. "If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Time the termination of cover crops to meet nutrient release goals. Termination at early vegetative stages may cause a more rapid release compared to termination at a more mature stage.

Both residue decomposition rates and soil fertility can affect nutrient availability following termination of cover crops

Allelopathic effects to the subsequent crop should be evaluated when selecting the appropriate cover crop.

Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

Additional Considerations to Reduce Erosion by Wind or Water

To reduce erosion, best results are achieved when the combined canopy and surface residue cover attains 90 percent or greater during the period of potentially erosive wind or rainfall.

Additional Considerations to Reduce Water Quality Degradation by Utilizing Excessive Soil Nutrients

Use deep-rooted species to maximize nutrient recovery.

When appropriate for the crop production system, mowing certain grass cover crops (e.g., sorghum-sudangrass, pearl millet) prior to heading and allowing the cover crop to regrow can enhance rooting depth and density, thereby increasing their subsoiling and nutrient-recycling efficacy.

Additional Considerations to Increase Soil Health and Organic Matter Content

Increase the diversity of cover crops (e.g., mixtures of several plant species) to promote a wider diversity of soil organisms, and thereby promote increased soil organic matter.

Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to provide nitrogen through biological nitrogen fixation.

Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the planning criteria and operation and maintenance requirements of this standard. Specifications shall describe the requirements to apply the practice to achieve the intended purpose for the practice site. Plans for the establishment of cover crops shall, as a minimum, include the following specification components in an approved Cover Crop, 340, Implementation Requirements document:

- Field number and acres
- Species of plant(s) to be established.
- Seeding rates.
- Seeding dates.
- Establishment procedure.
- Rates, timing, and forms of nutrient application (if needed).
- Dates and method to terminate the cover crop.
- Other information pertinent to establishing and managing the cover crop e.g., if haying or grazing is planned specify the planned management for haying or grazing.

NOTE:

Record the specifications using the Texas Cover Crop Calculator - Implementation Requirement Sheet

Located in the Texas NRCS Field Office Technical Guide: NRCS Field Office Technical Guide

OPERATION AND MAINTENANCE

Evaluate the cover crop to determine if the cover crop is meeting the planned purpose(s). If the cover crop is not meeting the purpose(s) adjust the management, change the species of cover crop, or choose a different technology.

REFERENCES

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Reeves, D.W. 1994. Cover crops and erosion. p. 125-172 *In* J.L. Hatfield and B.A. Stewart (eds.) Crops Residue Management. CRC Press, Boca Raton, FL.

NRCS Cover Crop Termination Guidelines:
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238

Revised Universal Soil Loss Equation Version 2 (RUSLE2) website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/rusle2/

Wind Erosion Prediction System (WEPS) website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/

USDA, Natural Resources Conservation Service, National Agronomy Manual, 4th Edition, Feb. 2011. Website: http://directives.sc.egov.usda.gov/ Under Manuals and Title 190.

Effects of NRCS Conservation Practices - National

Cover Crop

Crops including grasses, legumes, and forbs for seasonal cover and other conservation purposes.

Code: 340
Units: ac.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr				O	AL

Typical Landuse: C F R P Pr O AL

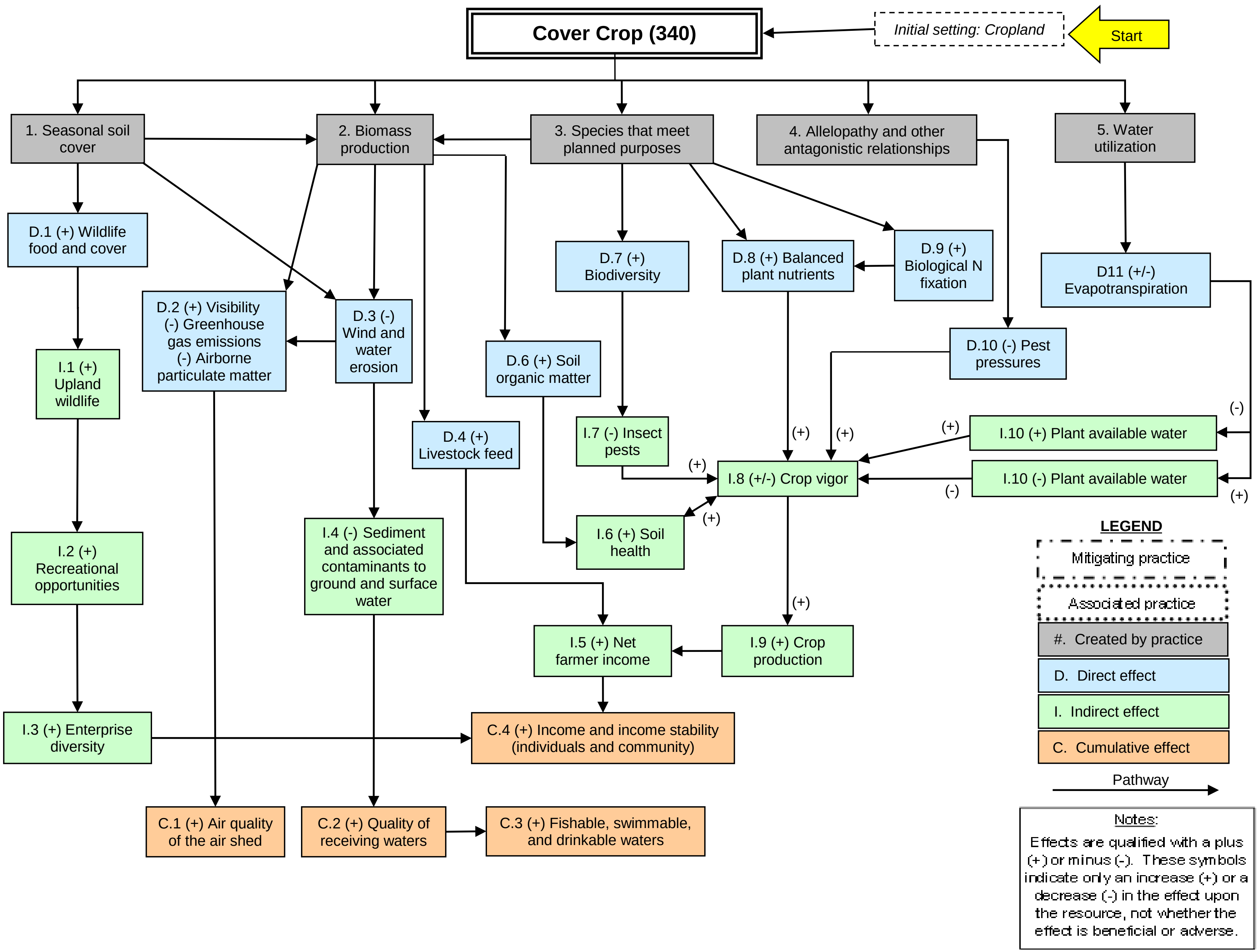
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	4	Increased cover during erosive periods will reduce soil detachment by water.
Soil Erosion - Wind Erosion	4	Increased cover during erosive periods will reduce soil detachment by wind.
Soil Erosion - Ephemeral Gully Erosion	3	Increased cover during erosive periods will reduce concentrated flow and associated soil detachment.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	More biomass produced will increase organic matter.
Compaction	2	Increased biomass and roots improve aggregation, which gives better resistance to compaction.
Subsidence	0	If it affects drainage the practice can have an impact on subsidence.
Concentration of Salts or Other Chemicals	1	Increased organic matter will buffer salts.
Excess Water		
Excess Water - Seeps	1	Growing plants will take up excess water. However, infiltration will increase, which may offset some of the benefits.
Excess Water - Runoff, Flooding, or Ponding	2	Growing plants will reduce runoff and increase infiltration.
Excess Water - Seasonal High Water Table	1	Growing plants will take up excess water. However, infiltration will increase, which may offset some of the benefits.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	1	Improves infiltration
Insufficient Water - Inefficient Moisture Management	2	Improves infiltration, soil structure, and winter water use that may otherwise be lost. For dry climates (<20 inches/year); cover crops will compete for main crop's moisture.
Water Quality Degradation		
Pesticides in Surface Water	2	The action reduces runoff and erosion.
Pesticides in Groundwater	2	The action increases soil organic matter, biological activity, and pesticide uptake.
Nutrients in Surface water	2	The action reduces erosion and runoff and transport of nutrients. Cover crops can uptake excess nutrients.
Nutrients in Groundwater	2	The action utilizes excess nutrients and increases organic matter. The additional organic matter will increase cation exchange capacity which will hold nutrients.
Salts in Surface Water	0	Less runoff reduces transport of soluble salts. Growing vegetation can use excess water which reduces seepage.
Salts in Groundwater	1	Cover crops can take up salts and water reducing the leaching potential of salts.
Excess Pathogens and Chemicals from Manure, Bio-solid	1	Less erosion and runoff reduces delivery of pathogens.
Excess Pathogens and Chemicals from Manure, Bio-solid	2	The action increases organic matter promoting microbial activity which competes with pathogens.

Excessive Sediment in Surface Water	2	Vegetation will reduce erosion and transport of sediment.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	3	Ground cover helps reduce wind erosion and generation of fugitive dust.
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	2	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Plants are selected and managed to maintain optimal productivity and health and can contribute to subsequent crop health and productivity.
Inadequate Structure and Composition	5	Plants selected are adapted and suited.
Excessive Plant Pest Pressure	4	Vegetation is installed and managed to control undesired species.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Increased quality and quantity of vegetation provides more food for wildlife.
Inadequate Habitat - Cover/Shelter	2	Increased quality and quantity of vegetation provides more cover for wildlife.
Inadequate Habitat - Water	4	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	2	Increased cover will increase space for wildlife. May be used to connect other cover areas.
Livestock Production Limitation		
Inadequate Feed and Forage	2	Cover crops will add supplemental forage.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	2	Cover crops can reduce nitrogen inputs.

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2014



United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

FILTER STRIP

CODE 393

(ac)

DEFINITION

A strip or area of herbaceous vegetation that removes contaminants from overland flow.

PURPOSE

This practice is used to accomplish one or more of the following purposes–

- Reduce suspended solids and associated contaminants in runoff and excessive sediment in surface waters.
- Reduce dissolved contaminant loadings in runoff
- Reduce suspended solids and associated contaminants in irrigation tailwater and excessive sediment in surface waters

CONDITIONS WHERE PRACTICE APPLIES

Filter strips are established where environmentally sensitive areas need to be protected from sediment, other suspended solids, and dissolved contaminants in runoff.

CRITERIA

General Criteria Applicable to All Purposes

Overland flow entering the filter strip will be uniform sheet flow.

Concentrated flow will be dispersed before it enters the filter strip.

The maximum gradient along the leading edge of filter strip will not exceed one-half of the up-and-down-hill slope percent, immediately upslope from the filter strip, up to a maximum of five percent.

Filter strips will not be used as a travel lane for equipment or livestock.

Additional Criteria to Reduce Dissolved Contaminants, Suspended Solids and Associated Contaminants in Runoff and Excessive Sediment in Surface Waters

The filter strip will be designed to have a 10-year life span, following the procedure in AgronomyTechnical Note No. 2 "Using Revised Universal Soil Loss Equation, Version 2 (RUSLE2) for the Design and Predicted Effectiveness of Vegetative Filter Strips (FVS) for Sediment," based on the amount of sediment delivery to the upper edge of the filter strip and ratio of filter strip flow length to length of flow path from the contributing area. The minimum flow length through the filter strip will be 20 feet for suspended solids and associated contaminants in runoff and 30 feet for dissolved contaminants and pathogens in runoff.

The filter strip will be located immediately downslope from the source area of contaminants.

The drainage area immediately above the filter strip will have a slope of one percent or greater.

Vegetation
The filter strip will be established to permanent herbaceous vegetation.

Species selected will be—

- Able to withstand partial burial from sediment deposition.
- Tolerant of herbicides used on the area that contributes runoff to the filter strip.
- Stiff stemmed and a high stem density near the ground surface.
- Suited to current site conditions and intended uses.
- Able to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities.

Plant species, rates of seeding (lbs/ac), vegetative planting (plants/ac), minimum quality of planting stock (pure live seed [PLS] or stem caliper), and method of establishment shall be specified before application. Only viable, high quality seed or planting stock will be used. Suitable species, planting rate and dates are shown in **Appendix 1**, Seeding Table.

The application of dead litter cover, where needed, will follow the guidance in **Appendix 2.**

Perform site preparation and seeding/planting at a time and in a manner that best ensures survival and growth of selected species. Successful establishment parameters, (e.g., minimum percent ground/ canopy cover, percent survival, stand density) will be specified before application.

Schedule planting dates during periods when soil moisture is adequate for germination and establishment. Seeding will be timed so that tillage for adjacent crop does not damage the seeded filter strip.

Where the purpose is to remove phosphorus, remove (or harvest) the filter strip aboveground biomass at least once each year.

The minimum seeding and stem density will be equivalent to the seeding rate for a high quality grass hay seeding rate for the climate area or the density of vegetation selected in current water erosion technology to determine trapping efficiency, whichever is the higher seeding rate.

Additional Criteria to Reduce Suspended Solids and Associated Contaminants in Irrigation Tailwater and Excessive Sediment in Surface Waters
Filter strip vegetation will be a small grain or other suitable annual plant.

The seeding rate shall be sufficient to ensure that the plant spacing does not exceed 4 inches (about 16–18 plants per square foot).

Establish filter strips prior to the irrigation season so that the vegetation is mature enough to filter sediment from the first irrigation.

CONSIDERATIONS

General Considerations
Filter strip width (flow length) can be increased as necessary to accommodate harvest and maintenance equipment.

Filters strips with the leading edge on the contour will function better than those with a gradient along the leading edge.

Seeding rates that establish a higher stem density than the normal density for a high quality grass hay crop will be more effective in trapping and treating contaminants.

When needed, invasive plant species may be controlled through mowing, herbicides, and hand weeding.

Consideration for Reducing Suspended Solids and Associated Contaminants in Runoff
Increasing the width fo the filter strip beyond the minimum required will increase the potential for capturing more contaminants in runoff.

Considerations for Creating, Restoring or Enhancing Herbaceous Habitat for Wildlife and Beneficial Insects and Pollinators
Filter strips are often the only break in the monotony of intensively-cropped areas. The wildlife and pollinator benefits of this herbaceous cover can be enhanced by the following:

- When appropriate, use native grass species that fulfill the purpose(s) of the practice while also providing habitat for priority wildlife.
- Adding herbaceous plant species (including native forbs) to the seeding mix that are beneficial to wildlife and pollinators and are compatible for one of the listed purposes. Changing the seeding mix should not detract from the purpose for which the filter strip is established.
- Increasing the width beyond the minimum required. The additional area can increase food and cover for wildlife and pollinators.
- Management activities on filter strips (mowing, burning, or light disking), should not be done more often than every other year with frequency dependent on geographical location to maintain the purpose(s) of the practice.
- Management activities should be completed outside of the primary nesting, fawning, and calving seasons. Activities should be timed to allow for regrowth before the growing season ends.
- Organic producers should submit plans and specifications to their certifying agent for approval prior to installation, as part of the organic producer's organic system plan.

Considerations to Maintain or Enhance Watershed Functions and Values
Filter strips may be used to enhance connectivity of corridors and noncultivated patches of vegetation within the watershed, enhance the aesthetics of a watershed, and be strategically located to reduce runoff, and increase infiltration and groundwater recharge throughout the watershed.

Increase Carbon Storage
Increasing the width of the filter strip beyond the minimum required will increase potential for carbon sequestration.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice will be prepared for each field or treatment unit. Record the specifications using the implementation requirements document. The specifications will identify at a minimum the following:

- Practice purpose(s).
- Length, width (width refers to flow length through the filter strip), and slope of the filter strip to accomplish the planned purpose(s).
- Plant species selection and seeding/planting/sprigging rates to accomplish the planned purpose.
- Planting dates and planting method(s).
- Specific care and handling requirements of the seed or plant material to ensure that planted materials have an acceptable rate of survival.
- A statement that only viable, high quality, and adapted seed will be used.
- Site preparation instructions sufficient to establish and grow selected species.

Note:

Record the specifications using the Texas Code 393 Practice Implementation Requirements document located in eFOTG Section IV – Conservation Practices – Filter Strip (Code 393) folder.

Locate the folder from the below link:

eFOTG-Document Locator

OPERATION AND MAINTENANCE

For the purposes of filtering contaminants and nutrients (phosphorus), permanent filter strip vegetative plantings will be harvested and removed as appropriate to encourage dense growth, maintain an upright growth habit and remove nutrients and other contaminants that are contained in the plant tissue.

Control undesired weed species, especially State-listed noxious weeds.

If Conservation Practice Standard (CPS) Prescribed Burning (Code 338) is used to manage and maintain the filter strip, an approved burn plan must be developed.

Inspect the filter strip after storm events and repair any gullies that have formed, remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed areas and take other measures to prevent concentrated flow through the filter strip.

Apply supplemental nutrients as needed to maintain the desired species composition and stand density.

Periodically regrade and reestablish the filter strip area when sediment deposition at the filter strip-field interface jeopardizes its function. Reestablish the filter strip vegetation in regraded areas, if needed.

If grazing is used to harvest vegetation from the filter strip, the grazing plan must ensure that the integrity and function of the filter strip is not adversely affected.

REFERENCES

Dillaha, T.A., J.H. Sherrard, and D. Lee. 1986. Long-Term Effectiveness and Maintenance of Vegetative Filter Strips. VPI-VWRRC Bulletin 153.

Dillaha, T.A., and J.C. Hayes. 1991. A Procedure for the Design of Vegetative Filter Strips: Final Report Prepared for U.S. Soil Conservation Service.

Foster, G.R. Revised Universal Soil Loss Equation, Version 2 (RUSLE2) Science Documentation (In Draft). USDA-ARS, Washington, DC. 2005.

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture. Agriculture Handbook 703.

Revised Universal Soil Loss Equation Version 2 (RUSLE2) Web site (checked May 2007): http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.

M.G. Dosskey, M.J. Helmers, and D.E. Eisenhauer 2008. A *Design Aid for Determining Width of Filter* Strips. Journal *of Soil and Water Conservation.* July/Aug *2008*—vol. 63, no. 4.

Effects of NRCS Conservation Practices - National

Filter Strip

A strip or area of herbaceous vegetation that removes contaminants from overland flow.

Code: 393
Units: ac.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr	FS	D		O	AL

Typical Landuse: C F R P Pr FS D O AL

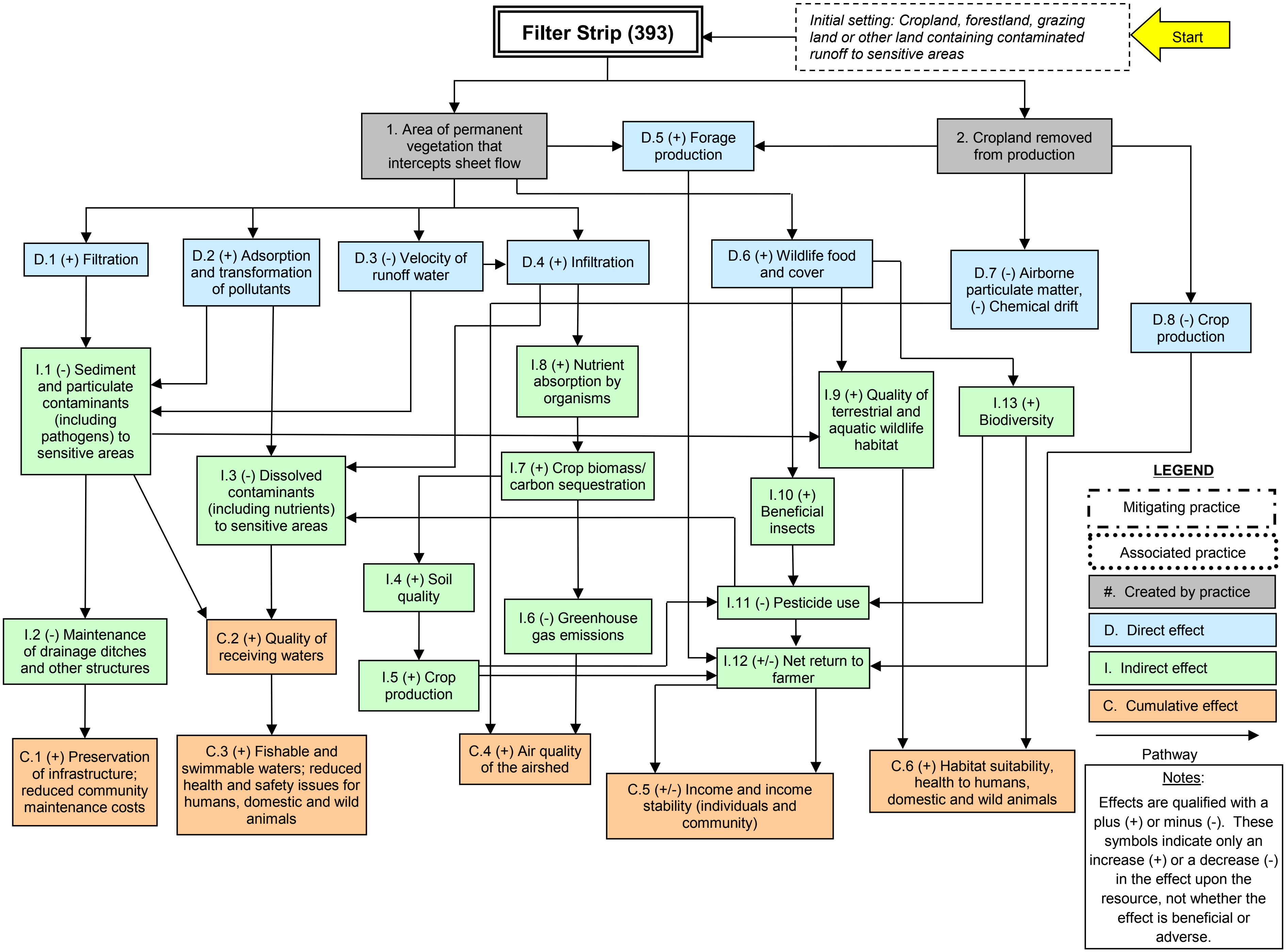
Soil Erosion	***Effect***	***Rationale***
Soil Erosion - Sheet and Rill Erosion	0	Not Applicable
Soil Erosion - Wind Erosion	0	Not Applicable
Soil Erosion - Ephemeral Gully Erosion	0	Not Applicable
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	5	Decreased erosion, increased root mass and less oxidation from lack of soil disturbance under permanent cover will increase or maintain organic matter.
Compaction	5	Root penetration and organic matter helps restore soil structure.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	0	Not Applicable
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	2	The action reduces runoff and traps adsorbed pesticides. Also, the strips may attract beneficial insects or trap insect pests, reducing the need for pesticide applications.
Pesticides in Groundwater	1	There is a potential to increase infiltration and absorption by plant roots and breakdown of pesticides with biological activity.
Nutrients in Surface water	5	Solid organics and sediment-attached nutrients are filtered out. Soluble nutrients infiltrate the soil and may be taken up by plants or utilized by soil organisms.
Nutrients in Groundwater	2	Permanent vegetation will take up available nutrients and increase organic matter. The increased organic matter will increase cation exchange capacity which will hold nutrients.
Salts in Surface Water	1	The action slows runoff, which may increase water infiltration, reducing the potential for transport of salts to surface water.
Salts in Groundwater	1	The action will result in increased uptake by plants.
Excess Pathogens and Chemicals from Manure, Bio-solid	3	Filter strips capture and delay pathogen movement, but mortality may also be delayed because vegetative cover may protect pathogens from desiccation.
Excess Pathogens and Chemicals from Manure, Bio-solid	1	The action captures and delays pathogen movement, but pathogen mortality may also be delayed because vegetative cover may protect pathogens from desiccation.

Excessive Sediment in Surface Water	5	Vegetation protects soil surface and traps sediment, nutrients and other materials.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	4	Runoff containing heavy metals is slowed, trapping sediment and increasing infiltration into the soil where metals are often tied up. Some plants can take up heavy metals.
Petroleum, Heavy Metals and Other Pollutants Transporte	1	Higher organic matter levels increases buffering capacity of the soil. Some plants can take up some heavy metals.
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	1	Areas converted to permanent vegetation reduce the area susceptible to wind erosion and tillage.
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	1	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	5	Plants are selected and managed to maintain optimal productivity and health.
Inadequate Structure and Composition	5	Plants selected are adapted and suited.
Excessive Plant Pest Pressure	4	Filter strips are installed and managed to control target species. Dense, permanent cover limits invasion by noxious plants.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Increased quality and quantity of vegetation provides more food and cover for wildlife, but vegetation removal limits cover.
Inadequate Habitat - Cover/Shelter	2	Increased quality and quantity of vegetation provides more food and cover for wildlife, but vegetation removal limits cover.
Inadequate Habitat - Water	0	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	2	Increased quality and quantity of vegetation provides more food and cover for wildlife, but vegetation removal limits cover.
Livestock Production Limitation		
Inadequate Feed and Forage	0	Not Applicable
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2016



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

CODE 590

(ac)

DEFINITION

Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve plant health and productivity
- Reduce excess nutrients in surface and ground water
- Reduce emissions of objectionable odors
- Reduce emissions of particulate matter (PM) and PM precursors
- Reduce emissions of greenhouse gases (GHG)
- Reduce emissions of ozone precursors
- Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water
- Improve or maintain soil organic matter

CONDITIONS WHERE PRACTICE APPLIES

All fields where plant nutrients and soil amendments are applied. Does not apply to one-time nutrient applications at establishment of permanent vegetation.

CRITERIA

General Criteria Applicable to All Purposes

State Regulations take precedence over this standard.

Develop a nutrient management plan for nitrogen (N), phosphorus (P), and potassium (K), which accounts for all known measurable sources and removal of these nutrients.

Sources of nutrients include, but are not limited to, commercial fertilizers (including starter and in-furrow starter/pop-up fertilizer), animal manures, legume fixation credits, green manures, plant or crop residues, compost, organic by-products, municipal and industrial biosolids, wastewater, organic materials, estimated plant available soil nutrients, and irrigation water.

When irrigating, apply irrigation water in a manner that reduces the risk of nutrient loss to surface and ground water.

Follow all applicable State requirements and regulations when applying nutrients near areas prone to contamination, such as designated water quality sensitive areas, (e.g., lakes, ponds, rivers and streams, sinkholes, wellheads, classic gullies, ditches, or surface inlets) that run unmitigated to surface or groundwater. These areas shall receive no direct application of nutrients.

Soil and tissue testing and analysis
Base the nutrient management plan on current soil test results in accordance with Texas A&M AgriLife Extension Soil, Water and Forage Testing Laboratory (SWFTL) guidance, or industry practice when recognized by SWFTL. See http://soiltesting.tamu.edu/ guidance, or industry practice when recognized by the Texas A&M AgriLife Extension (SWFTL).

For nutrient management plan revisions and maintenance, take soil tests on an interval recommended by Texas AgriLife SWFTL or as required by local rules and regulations.

A current soils test will be no older than 90 days upon initiating new plans.

Soil testing for phosphorus must be Mehlich III by (ICP) inductively coupled plasma.

Collect, prepare, store, and ship all soil and tissue samples following Texas A&M AgriLife Extension (SWFTL) guidance or industry practice. The test analyses must include pertinent information for monitoring or amending the annual nutrient plan. Follow Texas A&M AgriLife Extension (SWFTL) guidelines regarding required analyses and test interpretations.

Manure, organic by-product, and biosolids testing and analysis
Collect, prepare, store, and ship all manure, organic by-products, and biosolids following Texas A&M AgriLife Extension (SWFTL) guidance or industry practice when recognized by the Texas A&M AgriLife Extension (SWFTL). In the absence of such guidance, test at least annually, or more frequently if needed to account for operational changes (e.g., feed management, animal type, manure handling strategy, etc.) impacting manure nutrient concentrations. If no operational changes occur and operations can document a stable level of nutrient concentrations for the preceding 3 consecutive years, manure may be tested less frequently, unless Federal, State, or local regulations require more frequent testing. Follow Texas A&M AgriLife Extension (SWFTL) guidelines regarding required analyses and test interpretations. Analyze, as a minimum, total N, total P or P_2O_5, total K or K_2O, and percent solids.

When planning for new or modified livestock operations, and manure tests are not available yet, use the output and analyses from similar operations in the geographical area if they accurately estimate nutrient output from the proposed operation or use “book values” recognized by the NRCS (e.g., NRCS Agricultural Waste Management Field Handbook) and the Texas A&M AgriLife Extension (SWFTL).

For manure analyses, use laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification program under the auspices of the Minnesota Department of Agriculture or other NRCS-approved program that considers laboratory performance and proficiency to assure accurate manure test results.

For nutrient management plans developed as a component of a comprehensive nutrient management plan for an animal feeding operation (AFO) follow policy in NRCS directive General Manual (GM) 190, Part 405, “Comprehensive Nutrient Management Plans.” These plans must include documentation of all nutrient imports, exports, and on-farm transfers.

Nutrient values of manure, organic by-products and biosolids must be determined prior to land application.

Nutrient values of manure, organic by-products, soil amendments and biosolids (sewage sludge) must be determined prior to land application or as directed by Texas Commission on Environmental Quality (TCEQ) permit requirements. Any TCEQ testing requirements take precedence over this practice standard.

At a minimum, manure analyses shall identify total nitrogen, phosphorus, potassium, and percent moisture or percent solids, as appropriate for solids or effluent.

Salt concentration in the soil shall be monitored so that manure applications do not cause plant damage or negatively impact soil health.

Manure, organic by-products, compost, and biosolids (sewage sludge) samples must be collected and analyzed at least annually, or more frequently if needed to account for operational changes (feed management, animal type, manure handling strategy, etc.) impacting manure nutrient concentrations. If no operational changes occur, less frequent manure testing is allowable where operations can document a stable level of nutrient concentrations for the preceding three consecutive years, unless Federal, State, or Local regulations require more frequent testing. If there is no prior sampling history, manure testing shall be developed and maintained until a consistent (maintaining a certain nutrient concentration with minimal variation) level of nutrient values is realized for that operation.

Nutrient loss risk assessments
Use current NRCS-approved nitrogen, phosphorus, and soil erosion risk assessment tools to assess the site-specific risk of nutrient and soil loss. Sheet, rill and wind erosion must be managed to protect soil and water quality. Concentrated flow erosion (ephemeral and classic gully) must be managed with appropriate suite of conservation practices.

Complete an NRCS-approved nutrient risk assessment for nitrogen, see Agronomy Technical Note TX-11, “Nitrogen Leaching Index for Texas”, Revised December 2012, for guidance.

Refer to **Appendix 5, Table 1 or Table 2.**

A Nitrogen Leaching Index will be completed on CMU/fields receiving nitrogen applications, manures, organic by products or soil amendments that have gravelly, sandy or loamy sand surface textures. Appropriate measures will be planned to reduce leaching potential on sites with a leaching index greater than 2.

Complete an NRCS-approved nutrient risk assessment for P (Agronomy Technical Note Number 15 – Phosphorus Assessment Tool) must be completed when:

- Conservation Management Units receive manures, organic by-products or soil amendments.
- Inorganic forms are planned within a phosphorus impaired watershed (contributes to 303d-listed water bodies).

A phosphorus risk assessment will not be required when the NRCS, with concurrence of the State water quality control authority, has determined specific conditions where the risk of phosphorus loss is low. These fields must have a documented agronomic need for phosphorus; based on soil test phosphorus (STP) and SWFTL nutrient recommendations.

For Phosphorus risk assessment, see Agronomy Technical Note TX-15, “Phosphorus Assessment Tool for Texas”, Revised December 2012, for guidance.

The 4Rs of nutrient stewardship
Manage nutrients based on the 4Rs of nutrient stewardship—apply the right nutrient source at the right rate at the right time in the right place—to improve nutrient use efficiency by the crop and to reduce nutrient losses to surface and groundwater and to the atmosphere.

Nutrient source
Choose nutrient sources compatible with application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic content, and local climate to minimize risk to the environment.

Determine nutrient values of all nutrient sources (e.g. commercial fertilizers, manure, organic by-products, biosolids) prior to land application.

Determine nutrient contribution of cover crops, previous crop residues, and soil organic matter.

For operations following USDA's National Organic Program, apply and manage nutrient sources according to program regulations.

For enhanced efficiency fertilizer (EEF) products, use products defined by the Association of American Plant Food Control Officials as EEF and recommended for use by Texas A&M AgriLife Extension (SWFTL).

In areas where salinity is a concern, select nutrient sources that limit the buildup of soil salts. When manures are applied, and soil salinity is a concern, monitor salt concentrations to prevent potential plant or crop damage and reduced soil quality.

Apply manure or organic by-products on legumes at rates no greater than the Texas A&M AgriLife Extension (SWFTL) estimated N removal rates in harvested plant biomass, not to exceed P risk assessment limitations.

Maintain soil pH within ranges which enhance the adequate level for plant or crop nutrient availability and utilization. Refer to Texas A&M AgriLife Extension (SWFTL) documentation for guidance. Refer to "Table 1 of Agronomy Technical Note TX-13 –Liming Information and Recommendations" for recommended pH ranges for common crops.

For any single application of nutrients applied as liquid (e.g., liquid manure, nutrients in irrigation water, fertigation)—

- Do not exceed the soil's infiltration rate or water holding capacity in the top 24 inches of the soil profile.
- Apply so that nutrients move no deeper than the current crop rooting depth.
- Avoid runoff or loss to subsurface tile drains. Maintain soil pH within ranges which enhance the adequate level for plant or crop nutrient availability and utilization. Refer to Texas A&M AgriLife Extension (SWFTL) documentation for guidance. Refer to "Table 1 of Agronomy Technical Note TX-13 –Liming Information and Recommendations" for recommended pH ranges for common crops.

Nutrient rate

Plan nutrient application rates for N, P, and K using Texas A&M AgriLife Extension (SWFTL) recommendations or industry practices when recognized by the Texas A&M AgriLife Extension (SWFTL). Lower-than-recommended nutrient application rates are permissible if the client's objectives are met.

At a minimum, determine the rate based on crop/cropping sequence, current soil test results, and NRCS-approved nutrient risk assessments. Realistic yield goals will be used. This applies to all nutrient applications inorganic and organic.

Realistic yield goals must be established based on historical yield data, soil productivity information, climatic conditions, nutrient test results, level of management, and local research results considering comparable production conditions. Yield goal may be determined by collecting the actual yield for the past six years, dropping the highest and lowest yields in this time frame, then averaging the yields of the remaining four years. For new crops or varieties where Texas A&M AgriLife Extension (SWFTL) guidance is unavailable, industry-demonstrated yield and nutrient uptake information may be used.

Nitrogen and phosphorus application rates shall match the recommended rates as closely as possible. If actual application rates differ from the recommended fertilizer rates, records for the nutrient management plan shall document the reason. It may be difficult to locate phosphorus fertilizer formulations that do not include nitrogen. When recommended nutrient rates cannot be matched with available formulations, it may be best to meet 100% of the phosphorus recommendation and follow-up with the remaining required nitrogen.

When agricultural manures are land applied, application rates shall be consistent with the requirements of the NRCS conservation practice standard for Nutrient Management (590) and **Appendix 5, Table 1 or Table 2**.

Nutrient application timing and placement

Consider the nutrient source, management and production system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment to develop optimal timing of nutrients. For N, time the application as closely as practical with plant and crop uptake. For P, time planned surface application when runoff potential is low. Time the application of all nutrients to minimize potential for soil compaction.

For crop rotations or multiple crops grown in one year, do not apply additional P if it was already added in an amount sufficient to supply all crop nutrient needs.

To avoid salt damage, follow Texas A&M AgriLife Extension (SWFTL) recommendations for the timing, placement, and rate of applied N and K in starter fertilizer or follow industry practice recognized by the Texas A&M AgriLife Extension (SWFTL).

Do not surface apply nutrients when there is a risk of runoff, including when—

- Soils are frozen.
- Soils are snow-covered.
- The top 2 inches of soil are saturated.

Exceptions for the above criteria related to surface-applied nutrients when there is a risk of runoff can be made when specified conditions are met and adequate conservation measures are installed to prevent the offsite delivery of nutrients. NRCS, in cooperation with the State water quality control authority, will define adequate treatment levels and specified conditions for applications of manure if soils are frozen and/or snow covered or the top 2 inches of soil are saturated. At a minimum, must consider the following site and management factors:

- Climate (long-term)
- Weather (short-term)
- Soil characteristics
- Slope
- Areas of concentrated flow
- Organic residue and living covers
- Amount and source of nutrients to be applied
- Setback distances to protect local water quality

Timing and placement of all nutrients must correspond as closely as practical with plant nutrient uptake (utilization by crops), and consider nutrient source, cropping system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment (e.g., Nitrogen Leaching Index, Phosphorus Index) results.

Pre-plant nitrogen applications must not precede the normal planting date of the target crop by more than 120 days if incorporated within 48 hours and 30 days if surface applied.

Priority areas for land application of agricultural nutrients (organic and inorganic) should be on gentle slopes located as far as possible from waterways. When manures or effluent are applied on more sloping land or land adjacent to waterways that drains directly into the waterway, other conservation practices should be installed to reduce the potential for offsite transport of effluent or manures.

Effluent or manures will not be applied to slopes steeper than 8% with a runoff curve >80 or steeper than 16%slope with a runoff curve 70 or greater, unless applied as a component of an erosion control plan, i.e., Critical Area Planting (342), reclamation work, etc.

It is preferable to apply manures on pastures and hayland at spring greenup or soon after cutting or grazing before regrowth has occurred.

Heavy Metal Monitoring. When sewage sludge is applied, the accumulation of potential

pollutants (including arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc) in the soil shall be monitored in accordance with the TCEQ Regulations, TAC, Title 30, Chapter 312 – Sludge Use, Disposal and Transportation and any local laws or regulations.

Additional Criteria to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater

Apply conservation practices to avoid nutrient loss and control and trap nutrients before they can leave the field(s) by surface, leaching, or subsurface drainage (e.g., tile, karst) when there is a significant risk of transport of nutrients.

Use the current NRCS-approved nitrogen, phosphorus, and soil erosion risk assessment tools to assess the risk of nutrient and soil loss. Identified resource concerns must be addressed to meet current planning criteria (quality criteria). Technical criteria for risk assessments can be found in NI-190- 302.

Use conservation practices that slow runoff, reduce erosion, and increase infiltration, e.g., filter strip, contour farming, or contour buffer strips. These practices can also reduce the loss of nitrates or soluble phosphorus. When there is a high risk of transport of nutrients, conservation practices must be coordinated to avoid, control, or trap manure and nutrients before they can leave the field by surface or subsurface drainage (e.g., tile). The number of applications and the application rates must also be considered to limit the transport of nutrients to tile. All agricultural nutrients (organic and inorganic) shall be utilized in a manner that minimizes the opportunity for contamination of surface and ground water supplies.

When using an irrigation system for fertigation, the system shall be equipped with properly designed operating valves and components to prevent backflows into ground and surface water.

Nutrients must be applied with the right placement, in the right amount, at the right time, and from the right source to minimize nutrient losses to surface and groundwater. The following nutrient use efficiency strategies or technologies must be considered:

- soil test and tissue test
- incorporation or injection
- timing and number of applications
- soil nitrate N testing prior to planting
- coordinate nutrient applications with optimum crop nutrient uptake
- SWFTL and Texas A&M AgriLife Research and Extension recommended technologies that improve nutrient use efficiency and minimize surface or groundwater resource concerns.

Additional Criteria to Reduce the Risk of Potential Pathogens From Manure, Biosolids, or Compost Application From Reaching Surface and Groundwater

When applicable, follow proper biosecurity measures as provided in NRCS directives GM-130, Part 403, Subpart H, “Biosecurity Preparedness and Response.”

Follow all applicable Federal, Tribal, State, and local laws and policies concerning the application of manure, biosolids, or compost in the production of fresh, edible crops.

For multi-year nutrient budgets, the applications of irrigation water, organic by-products, effluent, manures, soil amendments, biosolids (sewage sludge), starter fertilizers, or pop-up fertilizers must be accounted for.

Biosolids (sewage sludge) shall be applied in accordance with TCEQ Regulations, TAC, Title 30, Chapter 312 – Sludge Use, Disposal and Transportation and any local regulations regarding the use of biosolids (sewage sludge) as a nutrient source.

Apply manure, biosolids, or compost with minimal soil disturbance or by injection into the soil unless it is being applied to an actively growing crop, a minimum of 30 percent residue exists, or there is a living cover that has a fibrous root system with 75 percent or more cover. Do not surface apply manure if a storm event is forecast within 24 hours.

A 100 feet vegetated buffer will be maintained between an application area and a water of the state as directed by TCEQ Chapter 321.

The required minimum distance (setback) will be maintained from private or public drinking water supply wells. A minimum application distance for water wells used exclusively for agricultural irrigation will be planned and implemented. An exception to the full well setback zone for a private drinking water well or a water well used exclusively for agricultural irrigation may be established by a licensed Texas professional engineer or licensed Texas professional geoscientist to document that additional wellhead protective measures will be or have been implemented that will prevent pollutants from entering the well and contaminating groundwater. Additional protective measures may include a sanitary seal, annular seal, a steel sleeve, or surface slab. Refer to Texas Commission on Environmental Quality, Chapter 321 – Control of Certain Activities by Rule, the prescribed setbacks are as follows public water supply well 500 feet; private drinking well 150 feet; agriculture irrigation well 100 feet.

When effluents are applied, the application rate shall not exceed the infiltration rate of the soil, and the amount shall not exceed the moisture holding capacity of the upper

24 inches of the soil profile at the time of application. Effluent application shall not result in direct runoff of effluent from edge of the field during the time of application. As guidance, refer to NRCS publication "Determining Effluent Application Rates" (December 2012) and NRCS Program Aid 1619 – "Estimate Soil Moisture by Feel and Appearance".

Effluents or manures shall not be applied to frozen, snow-covered or saturated soil if the potential risk for runoff exists. The basis for the decision to apply effluent or manures under these conditions shall be documented in the 590 Organic Nutrient Management Plan.

Manure testing analyses must be performed by laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification program (MTLCP) under the auspices of the Minnesota Department of Agriculture or SWFTL recognized program that considers laboratory performance and proficiency to assure accurate manure test results. The method of manure analyses as specified by SWFTL is found in **Appendix 3** under heading of "Biosolids".

Exceptions to Nutrient Timing and Placement criteria include a spill from an agricultural /AFO / CAFO manure/effluent storage facility is considered eminent. Any application made under these circumstances should be reported to TCEQ as soon as possible. Adjustments will need to be made to the NMP to account for this application and samples shall be collected for soils and manures as soon as sampling can be safely completed.

When manures are applied, and soil salinity is a concern, salt concentrations must be monitored to prevent potential crop damage and/or reduced soil health.

The total single application of liquid manure:

- must not exceed the soil's infiltration or water holding capacity to 24 inches
- be based on crop rooting depth
- must be adjusted to avoid runoff or loss to subsurface tile drains.

Crop production activities and nutrient use efficiency technologies must be coordinated to take advantage of mineralized plant-available nitrogen to minimize the potential for nitrogen losses due to denitrification or ammonia volatilization.

Nitrogen and phosphorus application rates must be planned based on risk assessment results as determined by NRCS-approved nitrogen and phosphorus risk assessment tools.

Application of all organic soil amendments will not exceed the values listed in **APPENDIX 5**, **Table 1** or **Table 2**.

Application rates under **APPENDIX 5**, **Table 2** are based on crop removal rates. A Nutrient Utilization Plan (NUP) is required where Soil Test P Level is equal to or greater than 200 ppm in non-arid areas, or equal to or greater than 350 ppm in arid areas with distance to a named stream greater than one mile, or equal to or greater than 200 ppm in arid areas with distance to a named stream less than one mile.

When phosphorus risk assessment results equate to HIGH or VERY HIGH risk and the soil test phosphorus level is greater than the critical phosphorus level for a given phosphorus index rating, additional phosphorus may be applied according to **APPENDIX 5**, **Table 1** or **Table 2** if the following requirements are met:

- a soil phosphorus drawdown strategy has been implemented, and
- a site assessment for nutrients and soil loss has been conducted to determine if mitigation practices are required to protect water quality.
- any deviation from these high-risk requirements must have the approval of the Chief of the NRCS.

There is a point above which the risk of phosphorus loss from a field is too great to warrant additional application of phosphorus for plant production. When soil test phosphorus levels are greater than or equal to 500 ppm, with a P-Index rating of "HIGH" or "VERY HIGH", there will be no additional application of phosphorus to a CMU or field.

Manure or organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in harvested plant biomass, not to exceed SWFTL recommendations.

Manure may be applied at a rate equal to the recommended phosphorus application, or estimated phosphorus removal in harvested plant biomass for the crop rotation, or multiple years in the crop sequence at one time. When such applications are made, the application rate must not exceed the acceptable phosphorus risk assessment criteria, must not exceed the recommended nitrogen application rate during the year of application or harvest cycle, and no additional phosphorus will be applied in the current year and any additional years for which the single application of phosphorus is supplying nutrients.

Additional practices to enhance the producer's ability to manage manure effectively include modification of the animal's diet to reduce the manure nutrient content or utilizing manure amendments that stabilize or tie-up nutrients.

Additional Criteria to Reduce Emissions of Objectionable Odors, PM and PM Precursors, and GHG and Ozone Precursors

To address air quality concerns caused by odor, N, sulfur, and particulate emissions; adjust the source, timing, amount, and placement of nutrients to reduce the negative impact of these emissions on the environment and human health.

Do not surface apply solid nutrient sources, including commercial fertilizers, manure, or organic by-products of similar dryness/density when there is a high probability that wind will blow the material and emissions offsite. Do not surface apply liquid nutrient sources when there is a high probability that wind will blow the liquid droplets applied from sprinklers or other applicable methods offsite.

Reduce the potential for volatilization by applying sources subject to volatilization during cooler, higher humidity conditions or by placement that minimizes vulnerability to volatilization.

To address air quality concerns caused by odor, nitrogen, sulfur, and/or particulate emissions; the source, timing, amount, and placement of nutrients must be adjusted to minimize the negative impact of these emissions on the environment and human health. One or more of the following may be used:

- slow or controlled release fertilizers
- nitrification inhibitors
- urease inhibitors
- nutrient enhancement technologies
- incorporation
- injection
- stabilized nitrogen fertilizers
- residue and tillage management
- no-till or strip-till
- windbreaks
- other technologies that minimize the impact of these emissions ADD

Do not apply poultry litter, manure, or organic by-products of similar dryness/density when there is a high probability that wind will blow the material from the application area.

Additional Criteria to Improve or Maintain Organic Matter

Design the plant or crop management systems so the soil conditioning index (SCI) organic matter subfactor is positive.

Apply manure, compost, or other organic nutrient sources at a rate and with minimal disturbance that will improve soil organic matter without exceeding acceptable risk of N or P loss.

For low residue plant or cropping systems, apply adequate nutrients to optimize plant or crop residue production to maintain or increase soil organic matter.

Time the application of nutrients to avoid periods when field activities will result in soil compaction. In areas where salinity is a concern, select nutrient sources that minimize the buildup of soil salts.

CONSIDERATIONS

General Considerations

Consider development of nutrient management plans by conservation management unit (CMU). A CMU is a field, group of fields, or other land units of the same land use and having similar treatment needs and planned management. A CMU is a grouping by the planner to simplify planning activities and facilitate development of conservation management systems. A CMU has definitive boundaries such as fencing, drainage, vegetation, topography, or soil lines.

Consider observing a 100 feet vegetated buffer between all nutrient application area and a water of the state.

If the area (CMU) conservation management unit represented by the soil test is extremely variable, the CMU should be separated into smaller areas where practical. Professional judgement should be used so that the CMUs are still of manageable size. In this way, some areas of the CMU will be treated differently from others to reduce variability so that the field can be sampled and treated as a unit in the future. Variability in a field can often be noted by differences in slope, soil texture, landscape position, previous crop, manure application history, surface soil color and crop growth or yield.

On organic operations, the nutrient sources and management must be consistent with the USDA's National Organic Program.

Soil pH must be maintained in a range that enhances an adequate level for crop nutrient availability and utilization. Refer to "Table 1 of Agronomy Technical Note TX-13 –Liming Information and Recommendations" for recommended pH ranges for common crops.

Develop site-specific yield maps using a yield monitoring system, multispectral imagery or other methods. Use the data to further delineate low- and high-yield areas, or zones, and make the necessary management changes. Use variable rate nutrient application based on site-specific factor variability. See NRCS directive Agronomy Technical Note (TN) 190, AGR.3, "Precision Nutrient Management Planning."

Use the adaptive nutrient management learning process to improve nutrient use efficiency on farms as outlined in NRCS' national nutrient policy in GM-190, Part 402, "Nutrient Management." Consider using an adaptive approach to adjust nutrient rate, timing, form, and placement as soil biologic functions and soil organic matter changes over time. See NRCS directive Agronomy Technical Note (TN) 190, AGR.7, "Adaptive Nutrient Management Process."

Do not apply K in situations where an excess (greater than soil test K recommendation) causes nutrient imbalances in crops or forages.

Use multistage drainage strategies to mitigate nutrient loss pathways, as applicable.

Use legume crops and cover crops to provide N through biological fixation. Cover crops with a carbon to nitrogen ratio below 20:1 can release a large amount of soluble N after being plowed or tilled into the soil when an actively growing crop is not present to take up nutrients, leading to increased risks of nitrate movement and nitrous oxide emissions. The nitrous oxide emissions often occur in high soil moisture conditions, such as when a legume cover crop is plowed down in fall or early spring. To avoid these losses, use grass-legume or grass-legume-forbs mixtures with a more balanced carbon to nitrogen ratio.

Use winter hardy grass cover crops to take up excess N after the cash crop growing season and promote contribution of the nitrogen to next plant or crop

Use application methods, timing, technologies or strategies to reduce the risk of nutrient movement or loss, such as—

- Split nutrient applications.
- Banded applications.
- Injection of nutrients below the soil surface.
- Incorporate surface-applied nutrient sources when precipitation capable of producing runoff or erosion is forecast within the time of a planned application.
- High-efficiency irrigation systems and technology.
- Enhanced efficiency fertilizers
  - Slow or controlled release fertilizers
  - Nitrification inhibitors
  - Urease inhibitors.
- Drainage water management.
- Tissue testing, chlorophyll meters, or real-time sensors.
- Pathogen management considerations.

When a recycled product (e.g., compost) is to be used as a nutrient source on food crops or as food for humans or animals, make sure that pathogen levels have been reduced to acceptable levels (reference the Food and Drug Administration's Food Safety Modernization Act at www.fda.gov/FSMA). When the recycled product has come from another farming operation, implement biosecurity measures and evaluate the risk of pathogen transfer that could cause plant or animal diseases.

Use manure treatment systems that reduce pathogen content from manure.

Implementing a soil health management system that reduces tillage or other soil disturbance, includes a diverse rotation of crops and cover crops, keeps roots growing throughout the year, and keeps the soils covered to reduce nutrient losses, and improves—

- Nutrient use efficiency, rooting depth, and availability of nutrients.
- Soil organic matter levels.
- Availability of nutrients from organic sources.
- Aggregate stability and soil structure.
- Infiltration, drainage, and aeration of the soil profile.
- Soil biological activity.
- Water use efficiency and available moisture.

Use targeted or prescribed livestock grazing to enhance nutrient cycling and improve soil nutrient cycling functions.

Elevated soil test P levels may lead to reduced mycorrhizal fungal associations and immobilize some micronutrients, such as iron, zinc, and copper.

Apply manure, compost, or other nutrient sources with minimal soil disturbance and at a rate that will improve soil organic matter without exceeding acceptable risk of N or P loss.

PLANS AND SPECIFICATIONS

In the nutrient management plan, document—

- Aerial site photograph(s), imagery, topography, or site map(s).
- Soil survey map of the site.
- Soil information including: soil type, surface texture, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and ponding frequency.
- Location of designated sensitive areas and the associated nutrient application restrictions and setbacks.
- Location of nearby residences, or other locations where humans may be present on a regular basis, that may be impacted if odors or PM are transported to those locations.
- Results of approved risk assessment tools for N, P, and erosion losses.
- Documentation establishing the application site presents a low risk for P transport to local water if P is applied in excess of crop requirement.
- Current and planned plant production sequence or crop rotation.
- All available test results (e.g. soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient budget and management plan are based.
- When soil P levels are increasing above an agronomic level, include a discussion of the risk associated with P accumulation and a proposed P draw-down strategy.
- Realistic yield goals for the crops (where applicable for developing the nutrient management plan).
- Nutrient recommendations for N, P, and K for the entire plant production sequence or crop rotation.
- Listing, quantification, application method and timing for all nutrient sources (including all enhanced

efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports, and onsite transfers.
- Guidance for implementation, operation and maintenance, and recordkeeping.

For variable rate nutrient management plans, also include—

- Geo-referenced field boundary and data collected that was processed and analyzed as a GIS layer or layers to generate nutrient or soil amendment recommendations per management zone. Must include site-specific yield maps using soils data, current soil test results, and a yield monitoring system with GPS receiver to correlate field location with yield.
- Nutrient recommendation guidance and recommendation equations used to convert the GIS base data layer or layers to a nutrient source material recommendation GIS layer or layers.
- After implementation, provide application records per management zone or as applied map within individual field boundaries (or electronic records) documenting source, timing, method, and rate of all nutrient or soil amendment applications.

If increases in soil P levels are expected above an agronomic level (i.e., when N-based rates are used), document—

- Soil P levels at which it is desirable to convert to P-based planning.
- A long-term strategy and proposed implementation timeline for soil test P drawdown from the production and harvesting of crops.
- Management activities or techniques used to reduce the potential for P transport and loss.
- For AFOs, a quantification of manure produced in excess of crop nutrient requirements.

OPERATION AND MAINTENANCE

Review or revise plans periodically to determine if adjustments or modifications are needed. At a minimum, review and revise plans as needed with each soil test cycle, changes in manure management, volume or analysis, plants and crops, or plant and crop management.

Monitor fields receiving animal manures and biosolids for the accumulation of heavy metals and P in accordance with LGU guidance and State law.

For animal feeding operation, significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment to ensure accurate distribution of material at planned rates. For products too dangerous to calibrate, follow Texas A&M AgriLife Extension (SWFTL) or equipment manufacturer guidance on proper equipment design, plumbing, and maintenance.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation to explain the difference.

Protect workers from and avoid unnecessary contact with nutrient sources. Take extra caution when handling anhydrous ammonia or when managing organic wastes stored in unventilated tanks, impoundments, or other enclosures.

Use material generated from cleaning nutrient application equipment in an environmentally safe manner. Collect, store, or field apply excess material in an appropriate manner.

Recycle or dispose of nutrient containers in compliance with State and local guidelines or regulations.

Maintain records for at least 5 years to document plan implementation and maintenance. Records must include—

- All test results (soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient management plan is based.
- Listing and quantification of all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports and onsite transfers.
- Date(s), method(s), and location(s) of all nutrient applications.
- Weather conditions and soil moisture at the time of application, elapsed time from manure application to rainfall or irrigation event(s).
- Plants and crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and plant or crop residues removed.
- Dates of plan review, name of reviewer, and recommended adjustments resulting from the review.

For variable rate nutrient management plans, also include—

- Maps identifying the variable application location, source, timing, amount, and placement of all plant and crop nutrients applied.
- GPS-based yield maps for crops where yields can be digitally collected.

Conduct periodic plan reviews to determine if adjustments or modifications to the plan are needed. At a minimum, plans must be reviewed and revised, as needed with each soil test cycle, changes in manure volume or analysis, crops, or crop management.

Significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment at least annually, to ensure accurate distribution of material at planned rates.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation for the change.

Records must be maintained for at least 5 years or longer if required by other Federal, State or local ordinances, programs or contract requirements, in order to document plan implementation and maintenance. As applicable, records include:

- soil, plant tissue, water, manure, and organic by-product analyses resulting in recommendations for nutrient application,
- quantities, analyses and sources of nutrients applied,
- dates and method(s) of nutrient applications, source of nutrients, and rates of application,
- weather conditions and soil moisture at the time of application; lapsed time to manure incorporation; rainfall or irrigation event,
- crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and crop residues removed,
- dates of plan review, name of reviewer, and recommended changes resulting from the review.
- Additional records for precision/variable rate sites must include:
  - maps identifying the variable application source, timing, amount, and placement of all plant nutrients applied, and
  - GPS-based yield maps for crops where yields can be digitally collected.

Material generated from cleaning nutrient application equipment should be utilized in an environmentally safe manner. Excess material should be collected and stored or field applied in an appropriate manner.

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Effects of NRCS Conservation Practices - National

Nutrient Management

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

Code: 590
Units: ac.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr	FS	D		O	AL

Typical Landuse:

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	0	Soil disturbance to incorporate fertilizer loosens the soil and buries surface residue which can increase erosion. Other application methods do not contribute to erosion.
Soil Erosion - Wind Erosion	0	Soil disturbance to incorporate fertilizer loosens the soil and buries surface residue which can increase erosion. Other application methods do not contribute to erosion.
Soil Erosion - Ephemeral Gully Erosion	0	Soil disturbance to incorporate fertilizer loosens the soil and buries surface residue which can increase erosion. Other application methods do not contribute to erosion.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	Management of pH and applying sufficient nutrients will maintain or enhance biomass production
Compaction	-2	Field operations on moist soils cause soil compaction.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	2	Matching plant requirements with nutrient applications decreases excess nutrient conditions and reduces salts and other contaminants
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	0	Not Applicable
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Excess nitrogen promotes shoot growth in relation to root growth.
Insufficient Water - Inefficient Moisture Management	0	Excess nitrogen promotes shoot growth in relation to root growth.
Water Quality Degradation		
Pesticides in Surface Water	0	Not Applicable
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	5	Right: Amount, source, placement, and timing (4R) provides nutrients when plants need them most.
Nutrients in Groundwater	5	The amount and timing of nutrient application are balanced with plant needs.
Salts in Surface Water	1	Proper nutrient application should reduce salinity if nutrient source contains salts.
Salts in Groundwater	1	Proper nutrient application should reduce salinity if nutrient source contains salts.
Excess Pathogens and Chemicals from Manure, Bio-solid	1	Decrease application of pathogens if nutrient source contains pathogens.
Excess Pathogens and Chemicals from Manure, Bio-solid	1	The action limits the amount of manure that can be applied thus preventing harmful levels of pathogens.

Excessive Sediment in Surface Water	0	Proper nutrient application will minimize losses due to runoff.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	2	Changing pH will alter the solubility of metals. The action will reduce the application rate of heavy metals if required.
Petroleum, Heavy Metals and Other Pollutants Transporte	2	Management of pH will alter the solubility of metals. The action will reduce the application rate of heavy metals, if required
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	3	The proper application of nitrogen can greatly reduce ammonia emissions. Proper application techniques can also reduce particulate emissions from solid manure and fertilizers.
Emissions of Ozone Precursors	2	The proper application of nitrogen can reduce NOx emissions. Proper application techniques can also reduce VOC emissions from manure.
Emissions of Greenhouse Gases (GHGs)	4	Management of nutrients optimizes the storage of soil carbon. The propoer application of nitrogen can reduce emissions of nitrous oxide.
Objectionable Odors	4	The proper application of nitrogen can reduce ammonia emissions. Proper application techniques can also reduce emissions of VOCs and other odorous compounds from manure.
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Nutrients and soil amendments are optimized to enhance health and vigor of desired species.
Inadequate Structure and Composition	2	Nutrients and soil amendments are optimized to enhance suited and desired species.
Excessive Plant Pest Pressure	0	Not Applicable
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	1	Management enhances production of any food species planted.
Inadequate Habitat - Cover/Shelter	1	Management enhances cover/shelter conditions.
Inadequate Habitat - Water	0	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	0	Not Applicable
Livestock Production Limitation		
Inadequate Feed and Forage	4	Nutrients are managed to ensure optimal production and nutritive value of the forage used by livestock.
Inadequate Shelter	0	Not Applicable
Inadequate Water	2	Management improves livestock water quality.
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

May 2019