Deepwater Horizon Oil Spill
Louisiana Trustee Implementation Group
Draft Phase 2 Restoration Plan and Environmental Assessment #7.1: Terrebonne HNC Island Restoration Project

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List of Acronyms

Acronym	Definition
AEP	Annual Exceedance Probability
BMP	Best Management Practice
BP	BP Exploration and Production, Inc.
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CPRA	Coastal Protection and Restoration Authority
CRMS	Coastwide Reference Monitoring System
CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act of 1972
DOI	U.S. Department of the Interior
DWH	Deepwater Horizon
DWH Trustees	Deepwater Horizon Oil Spill Natural Resource Trustees
E&D	Engineering and Design
EFH	Essential Fish Habitat
EMU	Environmental Management Unit
EO	Executive Order
ESA	Endangered Species Act of 1973
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GMFMC	Gulf of Mexico Fishery Management Council
HNC	Houma Navigation Canal
IPaC	U.S. Fish and Wildlife Service Information for Planning and Consultation
La. Admin. Code	Louisiana Administrative Code
La. Rev. Stat.	Louisiana Revised Statute
LA TIG	Louisiana Trustee Implementation Group
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDWF	Louisiana Department of Wildlife and Fisheries
LOSCO	Louisiana Oil Spill Coordinator’s Office
NAAQS	National Ambient Air Quality Standards
NAVD 88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act of 1969
NFWF	National Fish and Wildlife Foundation
NMFS	National Marine Fisheries Service (also known as NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration

Acronym	Definition
NOI	Notice of Intent
NPL	National Priorities List
NRCS	Natural Resources Conservation Service
NRDA	Natural Resource Damage Assessment
OCM	Office of Coastal Management (LDNR)
OLACP	Oyster Lease Acquisition and Compensation Program
OPA	Oil Pollution Act of 1990
PDARP/PEIS	Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement
RESTORE Act	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
RP/EA	Restoration Plan/Environmental Assessment
SAV	Submerged Aquatic Vegetation
TIG	Trustee Implementation Group
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

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 the BP Exploration and Production, Inc. (BP) Macondo well and causing loss of life and extensive natural resource 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 were released into the ocean (USDOJ, 2016). Oil spread from the deep ocean to the surface and nearshore environment from Texas to Florida. The oil came into contact with and injured natural resources as diverse as deep-sea coral, fish and shellfish, productive wetland habitats, sandy beaches, birds, sea turtles, other protected marine life, and services such as recreational use opportunities. 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 these response actions had collateral impacts on the environment and on natural resource services. The oil and other substances released from the well, in combination with these extensive response actions, together make up the DWH oil spill.

The DWH oil spill is subject to the provisions of the Oil Pollution Act (OPA) of 1990, which addresses preventing, responding to, and paying for oil pollution incidents in navigable waters, adjoining shorelines, and the exclusive economic zone of the United States. Under the authority of OPA, a council of federal and state Trustees (DWH Trustees[1]) was established to assess natural resource injuries resulting from the incident and to work to make the environment and public whole for those injuries. As required under OPA, the Trustees conducted a natural resource damage assessment (NRDA) to assess the natural resource injuries resulting from the spill and to determine the type and amount of restoration required to compensate the public for those injuries. The *Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement* (Final PDARP/PEIS) summarizes these injuries and a suite of restoration alternatives (DWH Trustees, 2016).

In the Final PDARP/PEIS, the DWH Trustees determined that the injuries caused by the DWH oil spill affected such a wide array of linked resources over such an enormous area that the effects of the spill must be described as constituting an ecosystem-level injury. Consequently, the DWH Trustees' chosen alternative for restoration planning employs a comprehensive, integrated ecosystem approach to address the ecosystem-level injury. The Final PDARP/PEIS describes a comprehensive restoration plan at a programmatic level to guide and direct the ecosystem-level restoration effort, based on the following five programmatic restoration goals:

- Restore and conserve habitat
- Restore water quality
- Replenish and protect living coastal and marine resources
- Provide and enhance recreational opportunities
- Provide for monitoring, adaptive management, and administrative oversight to support restoration implementation

The Final PDARP/PEIS also summarizes a suite of 13 restoration types that can be used to advance the Trustees' restoration goals (DWH Trustees, 2016, Figure 5.4-1). For example, the "Birds" restoration type can advance the goal of "replenish and protect living coastal and marine resources." The DWH Consent Decree with BP and the Final PDARP/PEIS include funding allocations for each restoration type and each Trustee as well as for monitoring, adaptive management, and administrative oversight. In total, these allocations include $8.8 billion in natural resource damage claims that will be paid over a 15-year period,

[1] The DWH Trustee Council comprises the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of the Interior (DOI), U.S. Department of Agriculture (USDA), U.S. Environmental Protection Agency (USEPA), and the states of Alabama, Florida, Louisiana, Mississippi, and Texas.

with $5 billion allocated to Louisiana through the Louisiana Trustee Implementation Group (LA TIG). These figures include funding that BP previously committed to pay for Early Restoration projects.

LA TIG Draft Phase 2 Restoration Plan and Environmental Assessment #7.1

The LA TIG previously prepared the *Louisiana Trustee Implementation Group Final Restoration Plan/Environmental Assessment #7: Wetlands, Coastal, and Nearshore Habitats and Birds* (Final RP/EA #7) pursuant to OPA and the National Environmental Policy Act (NEPA). The Terrebonne HNC Island Restoration Project was selected for engineering and design (E&D) in the Final RP/EA #7. This *Draft Phase 2 Restoration Plan and Environmental Assessment #7.1: Terrebonne HNC Island Restoration Project* (RP/EA #7.1) presents OPA NRDA and NEPA evaluations of design alternatives for the Terrebonne HNC Island Restoration project, 2) identifies a preferred design alternative for implementation, 7A, and 3) seeks input from the public on the plan. This Draft RP/EA #7.1 is consistent with the Final PDARP/PEIS and Record of Decision, OPA, and NEPA.

In identifying the preferred design alternative for this RP/EA, the LA TIG considered (1) the OPA NRDA regulations screening criteria found at 15 Code of Federal Regulations (CFR) 990.54, (2) specific goals identified by the DWH Trustees in the Final PDARP/PEIS and Final RP/EA #7 under the Birds restoration type, (3) goals developed by the LA TIG for this restoration plan, (4) input from the public, and (5) the current and future availability of funds under the DWH oil spill NRDA settlement payment schedule.

The LA TIG addresses the programmatic restoration goal to replenish and protect living coastal and marine resources by proposing implementation of the Terrebonne HNC Island Restoration project design alternative 7A. Design alternative 7A would implement the restoration approaches of “restore and conserve bird nesting and foraging habitat” and “create, restore, and enhance barrier and coastal islands and headlands” by increasing the acreage of the island from 27.6 acres to approximately 41.4 acres of shrub nesting, ground nesting, and marsh habitat. An existing, degraded perimeter rock dike would be restored, and breakwaters may be constructed on the northeast side of the island to provide further protection as well as calm water for loafing. Habitat restoration would be accomplished by raising the elevation of HNC Island using dredged material from a borrow area near Cat Island Pass. The estimated cost for implementing design alternative 7A is $34 million.

For this RP/EA, DOI serves as the lead federal agency responsible for NEPA compliance. The remaining federal and state agencies of the LA TIG are acting as cooperating agencies for the purposes of compliance with NEPA in the development of this RP/EA. In accordance with 40 CFR §1506.3(a), each of the federal cooperating agencies participating on the LA TIG will review the final RP/EA for adequacy in meeting the standards set forth in its own NEPA implementing procedures and expects to adopt the Final EA if appropriate.

The public is encouraged to review and comment on this Draft RP/EA #7.1, made available for public review and comment for 30 days, as specified in the public notice published in the Federal and Louisiana Registers. Comments may be submitted during the comment period by one of the following methods:

- Via the internet at the following URL: http://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana
- Via hard copy, write: U.S. Fish and Wildlife Service Gulf Restoration Office, 1875 Century Blvd, Atlanta, GA 30345
- Via webinar: registration for, and details specific to, the webinar are provided in a web story posted at the following URL: http://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana

Submissions must be postmarked no later than 30 days after the release date of the Draft RP/EA #7.1. To facilitate public comment, a public review meeting is scheduled via webinar for September 8, 2022, at 2:00 pm central time. Comments will be summarized in the Final RP/EA #7.1, and all public comments will be included in their entirety in the administrative record.

1 Introduction

The Louisiana Trustee Implementation Group[2] (LA TIG) prepared this *Draft Phase 2 Restoration Plan and Environmental Assessment #7.1: Terrebonne HNC Island Restoration Project* (RP/EA #7.1) for the restoration and conservation of bird habitat injured in the Louisiana Restoration Area as a result of the 2010 Deepwater Horizon (DWH) oil spill. This RP/EA was prepared in accordance with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) developed by the Deepwater Horizon Oil Spill Natural Resource Trustees[3] (DWH Trustees) (DWH Trustees, 2016) and Record of Decision, Oil Pollution Act of 1990 (OPA) and its associated natural resource damage assessment (NRDA) regulations, and the National Environmental Policy Act of 1969 (NEPA). This RP/EA is consistent with the *Louisiana Trustee Implementation Group Final Restoration Plan/Environmental Assessment #7: Wetlands, Coastal, and Nearshore Habitats and Birds* (Final RP/EA #7) (LA TIG, 2020b) and describes the DWH oil spill restoration planning process, considers design alternatives, and identifies the preferred alternative that would best help compensate the public for injuries to resources and habitats caused by the DWH oil spill in the Louisiana Restoration Area. The Final PDARP/PEIS and Final RP/EA #7 are hereby incorporated by reference. Links to online versions of these documents are included with their respective citations in Chapter 8.

The Terrebonne HNC Island Restoration project was selected for engineering and design (E&D) in the Final RP/EA #7. The E&D phase of this project has reached a point at which sufficient information is available to develop this RP/EA.

1.1 Background

The Final RP/EA #7 described the DWH NRDA restoration planning process, identified a reasonable range of restoration project alternatives to continue to address injuries to resources and habitats caused by the DWH oil spill, and selected from those alternatives a suite of five restoration alternatives to implement. Of those five, three projects were selected for E&D (one under the “Wetlands, Coastal and Nearshore Habitats” and two under the “Birds” restoration types). One of the projects under the Birds restoration type, the Terrebonne HNC Island Restoration project, has design alternatives ready for analysis in this RP/EA #7.1. As project alternatives were analyzed in RP/EA #7, only design alternatives are analyzed in this document.

The Final PDARP/PEIS sets forth the process for DWH restoration planning to select specific projects for implementation and establishes a distributed governance structure that assigns a Trustee Implementation Group (TIG) for each restoration area[4]. The LA TIG makes all restoration decisions for the funding allocated to the Louisiana Restoration Area. The Final PDARP/PEIS also outlines provisions for TIGs to phase restoration projects across multiple restoration plans. For example, a TIG may propose funding a planning phase (e.g., initial E&D and compliance) in one plan for a conceptual project (i.e., “Phase 1”). This allows the TIG to develop information needed to fully consider a subsequent implementation phase of that project in a future restoration plan (i.e., “Phase 2”).

In selecting projects for the Final RP/EA #7, the LA TIG considered:

[2] The LA TIG is comprised of five Louisiana state trustee agencies and four federal trustee agencies: the Louisiana Coastal Protection and Restoration Authority (CPRA), Louisiana Department of Environmental Quality (LDEQ), Louisiana Department of Natural Resources (LDNR), Louisiana Department of Wildlife and Fisheries (LDWF), Louisiana Oil Spill Coordinator’s Office (LOSCO), National Oceanic and Atmospheric Administration (NOAA), U.S. Department of the Interior (DOI), U.S. Department of Agriculture (USDA), and U.S. Environmental Protection Agency (USEPA).

[3] 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. Together with the members of the LA TIG, state Trustees authorized by the governors of Florida, Alabama, Mississippi, and Texas compose, as a whole, the DWH Trustees.

[4] There are eight restoration areas: Unknown Conditions, Regionwide, Open Ocean, Alabama, Florida, Louisiana, Mississippi, and Texas.

- OPA NRDA evaluation standards found at 15 Code of Federal Regulations (CFR) 990.54
- Restoration goals and other criteria identified by the Trustees in the Final PDARP/PEIS (DWH Trustees, 2016)
- Whether the project would restore bird nesting or foraging habitat or bird islands, enhance existing breeding colonies, support spatially distinct breeding colonies, and protect or restore for multiple resources
- The need to provide restoration benefits across the numerous Louisiana basins impacted by the DWH oil spill
- Current and future availability of funds under the DWH oil spill NRDA settlement payment schedule
- Input from the public

1.2 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 [U.S.C.] § 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 incidents involving an oil discharge or substantial threat of an oil discharge. This document was prepared in accordance with the OPA NRDA regulations (15 CFR § 990).

Federal Trustees must comply with NEPA, 42 U.S.C. § 4321 et seq. and its regulations, and 40 CFR § 1500 et seq., among others, when planning restoration projects. As authorized under NEPA at 40 CFR § 1501.11, the NEPA analysis in this RP/EA #7.1 tiers from the programmatic analysis in the Final PDARP/PEIS where appropriate.

DOI is the lead federal Trustee for preparing this RP/EA pursuant to NEPA (40 CFR § 1501.7). The other federal and state Trustees of the LA TIG are acting as cooperating agencies for the purposes of compliance with NEPA in the development of this RP/EA (40 CFR §§ 1501.8, 1508.1). Each federal cooperating agency on the LA TIG will review the analysis for adequacy in meeting the standards set forth in its own NEPA implementing procedures and subsequently adopt the NEPA analysis, if appropriate (40 CFR § 1506.3). Adoption would be completed via signature on the relevant NEPA decision document.

1.3 Purpose and Need

The LA TIG has undertaken this restoration planning effort to meet the purpose of contributing to the compensation for and restoration of natural resources and their services injured in the Louisiana Restoration Area as a result of the DWH oil spill. This RP/EA is consistent with the 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. This RP/EA falls within the scope of the purpose and need identified in the PDARP/PEIS. As described in Section 5.3 of the PDARP/PEIS, the Restoration Goals (Table 1-1) work independently and together to benefit injured resources and services. The reasonable range of design alternatives in this RP/EA addresses the programmatic restoration goal to 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 PDARP/PEIS.

1.4 Proposed Action

To address the restoration goals and purpose and need for action, the LA TIG proposes to implement the final design of the TIG's preferred design alternative for the Terrebonne HNC Island Restoration project using funds made available in the DWH Consent Decree.

The total LA TIG settlement funds allocated to the Birds restoration type in Louisiana was $148.5 million, and approximately $44 million has been allotted to other projects. Through this RP/EA, the LA TIG

proposes to use approximately $34 million of the remaining funds. Implementation of the proposed action would leave a balance of approximately $70.5 million and any unallocated earned interest remaining for future restoration plans that seek to fund projects under the Birds restoration type. Detailed information on all design alternatives can be found in Chapter 2.

1.4.1 Terrebonne HNC Island Restoration Project

The LA TIG addresses the programmatic restoration goal to replenish and protect living coastal and marine resources by proposing implementation of the Terrebonne HNC Island Restoration project design alternative 7A. Design alternative 7A would implement the restoration approaches of restore and conserve bird nesting and foraging habitat and create, restore, and enhance barrier and coastal islands and headlands by increasing the acreage of HNC Island from 27.6 acres to approximately 41.4 acres of shrub nesting, ground nesting, and marsh habitat. An existing, degraded perimeter rock dike would be restored, and breakwaters may be constructed on the northeast side of the island to provide further protection as well as calm water for loafing. Habitat restoration would be accomplished by raising the elevation of HNC Island using dredged material from a borrow area near Cat Island Pass. See Section 3.1.1 for a more detailed description.

1.5 Other Design Alternatives Analyzed in this RP/EA #7.1

In this document, the LA TIG screens several designs and establishes a reasonable range of alternatives, fully analyzing Terrebonne HNC Island Restoration project design alternatives 7 and 7A under the OPA NRDA regulations and NEPA. See Sections 3.1.1 and 3.1.2 for detailed descriptions.

1.6 Natural Recovery/No Action Alternative

Under the natural recovery/no action alternative, none of the action alternatives would be implemented. Under the OPA NRDA regulations, Trustees must consider a natural recovery alternative. In the PDARP/PEIS, the Trustees analyzed the natural recovery/no action alternative programmatically (Section 3.7, DWH Trustees, 2016) and found that it would not meet the purpose and need of restoring lost natural resources and their services and is therefore not analyzed in this document. That analysis is incorporated herein by reference. Pursuant to NEPA, a no action alternative is included as a benchmark, enabling decision-makers to compare the magnitude of environmental effects of the action alternatives (40 CFR § 1502.14).

1.7 Coordination with Other Gulf Restoration Programs

As discussed in Section 1.5.6 of the Final PDARP/PEIS and Section 1.8 of the Final RP/EA #7, the LA TIG is committed to coordination with other Gulf of Mexico restoration programs to maximize the overall ecosystem impact of DWH NRDA restoration efforts. This coordination will ensure that funds are allocated for critical restoration projects across the affected regions of the Gulf of Mexico and within Louisiana.

During the restoration planning process, the LA TIG has coordinated and will continue to coordinate with other DWH oil spill and Gulf of Mexico restoration programs, including the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States (RESTORE Act); the National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit Fund; and the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) programs. In doing so, the LA TIG has reviewed the implementation of projects in other coastal restoration programs and is striving to develop synergies with those programs to ensure the most effective use of available funds for the maximum coastal benefit. Additionally, the LA TIG has coordinated with the project teams for Queen Bess Island (RP/EA #1.1 [LA TIG, 2019]) and Rabbit Island (RP/EA #1.3 [LA TIG, 2020a]) to gain insight into bird island project design, best practices, and lessons learned and to apply those insights to the Terrebonne HNC Island Restoration project.

1.8 Public Involvement

Public input is an integral part of NEPA, OPA, and the DWH oil spill restoration planning effort. On October 1, 2010, the Trustees published a Notice of Intent (NOI) to Conduct Restoration Planning (75

Federal Register 60800). Since then, the Trustees have sought restoration project ideas from the public through a variety of means. In addition, the Trustees implemented an extensive public outreach process as part of Final PDARP/PEIS development efforts; that process and associated public comments are described more fully in Chapter 8 of the Final PDARP/PEIS (DWH Trustees, 2016).

1.8.1 Prior Public Review and Comment Opportunities

On August 20, 2020, the LA TIG posted in the Federal Register a Notice of Availability of the Draft RP/EA #7 for public review and comment (85 Federal Register 51475). The Terrebonne HNC Island Restoration project was proposed for E&D in that RP/EA. After a 30-day public comment period, the Terrebonne HNC Island Restoration project was approved for E&D funding. The public comment provided on the Terrebonne HNC Island Restoration project indicated that restoration of the island would enhance resiliency for seabirds in the face of a range of threats and suggested that the LA TIG consider designing the vegetation and slope profiles to maximize benefits to sand nesting species. On May 4, 2022, the LA TIG posted a NOI on the NOAA Gulf Spill Restoration website (https://www.gulfspillrestoration.noaa.gov/), informing the public that it was beginning to draft a restoration plan to evaluate construction projects identified for E&D in the Final RP/EA #7. That NOI indicated that the Isle au Pitre Restoration project would be included in RP/EA #7.1; however, as E&D progressed on that project concurrent with the writing of RP/EA #7.1, the LA TIG determined additional information was needed before construction alternatives for that project could be adequately developed. Construction alternatives for the Isle au Pitre Restoration project may still be analyzed in a future LA TIG restoration plan.

1.8.2 Public Review and Comment Opportunity for the Draft RP/EA #7.1

The public is encouraged to review and comment on this Draft RP/EA #7.1, made available for public review and comment for 30 days, as specified in the public notice published in the Federal and Louisiana Registers. Repositories with hard copies available can be found in Table 7-1. Comments may be submitted during the comment period by one of the following methods:

- Via the internet at the following URL: http://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana
- Via hard copy, write: U.S. Fish and Wildlife Service Gulf Restoration Office, 1875 Century Blvd, Atlanta, GA 30345
- Via webinar: registration for, and details specific to, the webinar are provided in a web story posted at the following URL: http://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana

Submissions must be postmarked no later than 30 days after the release date of the Draft RP/EA #7.1. To facilitate public comment, a public review meeting is scheduled via webinar for September 8, 2022, at 2:00 pm central time, followed immediately by the LA TIG's Annual Meeting. Comments will be summarized in the Final RP/EA #7.1, and all public comments will be included in their entirety in the administrative record.

1.9 Next Steps

The LA TIG will accept public comments and host a public webinar to facilitate the public review and comment process. After the close of the public comment period, the LA TIG will consider all input received during the public comment period and finalize this draft RP/EA, if appropriate. A summary of comments received and the LA TIG's responses (where applicable) will be included in the final RP/EA.

1.9.1 Administrative Record

The DWH Trustees opened a publicly available administrative record for the NRDA for the DWH oil spill, including restoration planning activities, concurrently with publication of the 2010 NOI (pursuant to 15 CFR § 990.45). DOI is the federal Trustee that maintains the administrative record, which can be found online at the following URL: http://www.doi.gov/deepwaterhorizon/adminrecord. This administrative record site is also used by the LA 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 the following URL: http://www.gulfspillrestoration.noaa.gov.

2 Restoration Planning Process: Project Alternatives and Screening

Following the DWH oil spill and pursuant to OPA , the Trustees initiated an injury assessment that established the nature, degree, and extent of injuries from the DWH incident to both natural resources and the services they provide. The Trustees then used the results of the injury assessment to inform restoration planning ensuring restoration addresses the nature, degree, and extent of the injuries caused by the DWH oil spill.

2.1 Final RP/EA #7

Consistent with the 13 restoration types described in the Final PDARP/PEIS (DWH Trustees, 2016), in the Final RP/EA #7, the LA TIG addressed two restoration types: Wetlands, Coastal, and Nearshore Habitats; and Birds. The Final RP/EA #7 analyzed a reasonable range of project alternatives anticipated to meet the restoration goals for each of the restoration types. In addition to the OPA NRDA evaluation standards that were applied, the LA TIG established and applied additional evaluation and selection criteria (LA TIG, 2020b).

In the Final RP/EA #7, the LA TIG screened project alternatives at the conceptual design stage based on geographic location, immediacy, and sustainability of project benefits provided for those that could best restore injured Wetlands, Coastal, and Nearshore Habitats as well as suitable colonial waterbird habitat on coastal islands (Birds). The LA TIG also screened project alternatives at the final design stage to restore Wetlands, Coastal, and Nearshore Habitats. Through that analysis, the LA TIG narrowed the range of alternatives to a suite of projects:

- Grande Cheniere Ridge Marsh Creation (construction)
- Terrebonne Basin Ridge and Marsh Creation Project: Bayou Terrebonne Increment (construction)
- Bird's Foot Delta Hydrologic Restoration (E&D)
- Pointe aux Chenes Ridge Restoration and Marsh Creation (E&D)
- Isle au Pitre Restoration (E&D)
- Terrebonne HNC Island Restoration (E&D)
- New Harbor Island Restoration (E&D)

This reasonable range of project alternatives was carried further into the screening and evaluation process to inform the LA TIG's choice of preferred alternatives. Each project in the reasonable range was evaluated according to the OPA NRDA evaluation standards (15 CFR. § 990.54(a)), which include:

- The cost to carry out the alternative
- The extent to which each alternative is expected to meet the goals and objectives of returning the injured natural resources and services to baseline and/or compensating for interim losses
- The likelihood of success of each alternative
- The extent to which each alternative would prevent future injury as a result of the incident 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

Of the seven project alternatives fully evaluated according to OPA NRDA regulations, the LA TIG selected two projects to move to construction and three projects to undergo E&D:

- Grande Cheniere Ridge Marsh Creation (construction)
- Terrebonne Basin Ridge and Marsh Creation Project: Bayou Terrebonne Increment (construction)

- Bird's Foot Delta Hydrologic Restoration (E&D)
- Isle au Pitre Restoration (E&D)
- Terrebonne HNC Island Restoration (E&D)

The OPA NRDA evaluation for the Terrebonne HNC Island Restoration E&D project can be found in Table 3-3 in Section 3.3 of the Final RP/EA #7 (LA TIG, 2020b) and has been incorporated by reference herein.

2.2 RP/EA #7.1

The Terrebonne HNC Island Restoration project is at a sufficient stage in the E&D process to conduct meaningful OPA NRDA and NEPA analyses on the reasonable range of design alternatives; therefore, the LA TIG initiated preparation of this RP/EA.

2.3 Design Alternatives and OPA NRDA Screening

2.3.1 Terrebonne HNC Island Restoration Project Design Alternatives and OPA Screening

In addition to the no action alternative, seven design alternatives were evaluated for the Terrebonne HNC Island Restoration project (Figure 2-1). The design alternatives represent a mix of topographic configurations (e.g., uniform sloping, double slope), island habitat configurations (e.g., marsh habitat adjacent to ground nesting habitat, centrally located marsh, etc.), and additional features (e.g., breakwaters, bird ramps, etc.) that were considered. The topographic configurations, habitat configurations, and additional features included in the design alternatives are summarized below; the Alternatives Analysis Technical Memorandum (ASCE, 2022a) and Basis of Design Technical Memorandum (ASCE, 2022b) fully describe all configurations and features and are incorporated herein by reference. Note that all elevations in this document are provided in North American Vertical Datum of 1988 (NAVD 88) unless stated otherwise.

Topographic Configurations

- Uniform sloping: this island topography configuration would result in sloping the full island from ground nesting habitat (highest elevation) to marsh habitat (lowest elevation).
- Double slope: this island topography configuration would drain the northern and southern island cells independently allowing for greater slopes and more effective drainage.

Island Habitat Configurations

- Marsh adjacent to ground nesting: this island habitat configuration would create ground nesting habitat adjacent to marsh habitat.
- Centrally located marsh: this island habitat configuration would locate the marsh at the center of the island rather than on the northwestern or southeastern edge.
- Northern ground nesting: this island habitat configuration would locate ground nesting habitat in the northern island cell.
- Full island integration: this island habitat configuration would require use of the entire island to achieve the habitat acreage goals, and it optimizes habitats based on topography.
- 2-cell configuration: this island habitat configuration takes advantage of the current 2-cell configuration of the island and incorporates a ridge above the existing internal rock dike that separates the cells.
- Reverse configuration: this island habitat configuration would reverse the current habitat configuration of the island such that ground nesting habitat would be on the northwestern end of the island, shrub nesting habitat would be near the middle of the island, and marsh habitat would begin on the southeastern end of the island.

Additional Features

- Tidal exchange: this feature would require designing low points in the perimeter rock dike that would allow for exchange with tidal fluctuations.
- Breakwaters: this feature would require establishing rock breakwaters outside the island perimeter to protect tidal exchange points from wave action, increase island longevity, and create areas of calm water for loafing.
- Bird ramps: this feature would result in filling the external rock dike with smaller rock so that small ground-nesting birds can access the exterior of the island without falling into voids in the rock dike.

As project design progressed, the footprint of design alternative 7 was reduced by approximately 12.1 acres to fit the available project budget, and the habitat goals of the reduced footprint were modified to focus on maximizing the shrub nesting habitat and protecting the existing marsh habitat on the northern side of the island. This reduction in project footprint does not impact the programmatic restoration goal of replenishing and protecting living coastal and marine resources. The reduced version of design alternative 7 is referred to as design alternative 7A. Table 2-1 provides the total habitat acreage that would be created by each of the seven design alternatives as well as the acreage of each habitat type. Alternative 1 represents the no action alternative; Alternatives 2-7A represent the design alternatives evaluated.

Figure 2-1. Design Alternatives Evaluated.
Note: Alternative 1 represents the no action alternative and is not included.

Table 2-1. Habitat Acreage and Conceptual Construction Costs for Each Design Alternative Evaluated.
Note: Alternative 1 represents the no action alternative and is not included.

Design Alternative	Ground Nesting	Shrub Nesting	Marsh	Total	Cost
2 – Uniform Sloping without Ridge	7.7	36.6	7.5	51.8	$28,943,422.64
3 – Reverse Configuration without Ridge	7.5	36.9	7.5	51.9	$30,270,344.87
4 – Double Slope with Ridge	8.5	36.3	7.6	52.4	$29,207,061.71
5 – Ground Nesting to Marsh Habitat without Ridge	7.5	36.9	7.5	51.9	$28,602,513.23
6 – North Ground Nesting with Ridge	7	38.6	7.7	53.3	$29,228,156.81
7 – North Ground Nesting with Nourishment and Ridge	7	36	10.3	53.3	$28,326,376.77
7A – North Ground Nesting with Nourishment and Ridge	3.9	27	10.5	41.4	$21,543,714.95

Each of the seven design alternatives would include a rock dike around the perimeter of the island; the target elevation of the rock dike would be roughly +5.0 feet. Additionally, each alternative would also include bird ramps in areas where ground nesting habitat is adjacent to the rock dike (although the acreage and location vary between alternatives) (ASCE, 2022a). Each of the alternatives may include the construction of breakwaters (although the location, number, and configuration of breakwaters varies between alternatives). Each of the alternatives was evaluated against seven criteria as follows: species habitat goals, restoration of natural habitat, long-term maintenance, constructability, vulnerability to wind and wave energy, construction duration, and preliminary project cost. The following potential borrow source alternatives were also evaluated as part of the alternatives analysis: Houma Navigation Canal (HNC), Cat Island Pass, Wood Resources sand borrow pit, and several additional offshore borrow locations. The project team considered three potential ways to source the sand required for island restoration: (1) hydraulically dredging and transporting the sediment via pipeline from an offshore borrow area, (2) hydraulically dredging and transporting the sediment via barge from an offshore borrow area, and (3) sourcing the sediment from a local borrow pit. The Alternatives Analysis Technical Memorandum (ASCE, 2022a) should be consulted for full details of the evaluation process; it is incorporated herein by reference.

The LA TIG evaluated the design alternatives based on the OPA NRDA restoration evaluation standards as described in Table 2-2.

Table 2-2. Evaluation of Design Alternatives.

Standard	Evaluation
Cost to carry out the alternative	Conceptual costs were developed at the beginning of the E&D phase and were refined as the design alternatives were further developed. Design alternative 7A was the most cost effective ($21.5 million), followed by design alternative 7 ($28.3 million). The least cost-effective option was design alternative 3 ($30.3 million). On a cost per acre basis, these costs are reasonable and appropriate according to the LA TIG.
Extent to which the alternative meets the Trustees' goals	All design alternatives are consistent with the Final PDARP/PEIS and the Final RP/EA #7. The design alternatives are consistent with the restoration approach of "create, restore, and enhance barrier and coastal islands and headlands" described in the Final PDARP/PEIS to address the DWH Oil Spill Trustees' programmatic restoration goal to replenish and protect living coastal and marine resources. The Final RP/EA #7 considered whether the project alternatives would restore bird nesting or foraging habitat or bird islands, enhance existing breeding colonies, support spatially distinct breeding colonies, and protect or restore for multiple resources.
Likelihood of success	All design alternatives are likely to succeed because they are technically feasible and utilize proven and established restoration methods, which have been implemented successfully on other projects in the region.
Extent to which the alternative would prevent future injury as a result of the incident and avoid collateral injury as a result of implementing the alternative	During implementation, best management practices (BMP) would be employed, and activities would be conducted according to any conditions arising from consultations and permitting to avoid and minimize collateral injury to natural resources.
Extent to which the project would benefit more than one natural resource and/or service	All design alternatives would provide suitable nesting habitat for colonial waterbirds, a primary benefit of the project, by restoring bird habitat on HNC Island. All design alternatives would also provide benefits to a range of other avian and aquatic species that would use the habitat.
Effect on public health and safety	The LA TIG does not anticipate impacts to public health and safety from implementing any of the design alternatives. HNC Island is uninhabited, remote, and accessible only by boat or air. During construction, all laws and regulations pertaining to worker safety would be followed. The Terrebonne HNC Island Restoration project would result in long-term, beneficial effects to public health and safety through the restoration and expansion of the island footprint, implementation of shoreline protection features, and resulting reductions in wave action and increase in island elevation.

In summary, the OPA NRDA evaluation demonstrates that the costs of the design alternatives are well documented, reasonable, and appropriate. The design alternatives have a strong nexus to the bird related injury caused by the DWH oil spill and can reasonably be expected to provide benefits to bird habitats and breeding populations over an extended timeframe. Further, the design alternatives would restore bird habitat to resources that were injured by the DWH oil spill and have a high probability of success. Finally, public safety issues are not expected to be a concern. Therefore, the LA TIG chose the two most cost-effective designs, alternatives 7 and 7A, to carry forward as the reasonable range.

2.3.2 Natural Recovery/No Action Alternative

Pursuant to the OPA regulations, the Final PDARP/PEIS considered "a natural recovery alternative by which no human intervention would be taken to directly restore injured natural resources and services to baseline" (15 CFR § 990.53(b)(2)). Under a natural recovery alternative, no additional restoration would be carried out by the LA TIG, at this time, to accelerate the recovery of birds in the Louisiana Restoration Area using DWH NRDA funding. The LA TIG would allow natural recovery processes to occur, which could result in one of four outcomes for injured resources: (1) gradual recovery, (2) partial recovery, (3) no recovery, or (4) further deterioration.

Due to sea level rise and subsidence, the most likely future outcomes are no recovery and further deterioration. If recovery were to occur naturally, it would occur over a longer period of time compared to a scenario by which restoration actions were undertaken. Given that technically feasible restoration approaches are available to compensate for interim natural resource and service losses, the DWH Trustees rejected this alternative from further OPA NRDA evaluation in the Final PDARP/PEIS (DWH Trustees, 2016). Based on this determination and incorporating that analysis by reference, the LA TIG did not further evaluate natural recovery as a viable alternative under the OPA NRDA regulations. A no action alternative is included in this RP/EA analysis. This was done pursuant to NEPA as a "benchmark, enabling decisionmakers to compare the magnitude of environmental effects of the action alternatives." The no action alternative is analyzed in Chapter 4.

3 Reasonable Range of Alternatives

According to the NRDA regulations under OPA, the Trustees must consider a reasonable range of restoration alternatives (15 CFR § 990.53(a)(2)) from which to choose their preferred alternatives. The LA TIG's screening process, which was based on evaluations using the OPA NRDA evaluation standards, resulted in a reasonable range of design alternatives. The reasonable range consists of two Terrebonne HNC Island Restoration project design alternatives, alternatives 7 and 7A (a modification of alternative 7). In this chapter, the LA TIG presents a thorough and comprehensive analysis to uniformly and objectively assess these alternatives.

3.1 Terrebonne HNC Island Restoration Project

The sections below describe design alternative 7A (3.1.1), design alternative 7 (3.1.2), and the LA TIG's rationale for preferring alternative 7A for the Terrebonne HNC Island Restoration project (3.1.3).

3.1.1 Design Alternative 7A

Design alternative 7A would combine double slope topography and a 2-cell habitat configuration with marsh habitat at three distinct elevations, including a centrally located marsh (Figure 3-1). Restoration across habitat types would increase the acreage of the island from 27.6 acres to approximately 41.4 acres (Table 3-1). Shoreline protection features include a rock dike around the island perimeter and may include breakwaters on the northeast side of the project area outside of the perimeter rock dike. Breakwaters would provide calm water for loafing, protect locations of tidal exchange that would occur in marsh habitat via low points in the perimeter rock dike, and extend the longevity of the island. The estimated cost for implementation of design alternative 7A is approximately $34 million, including operation, maintenance, and monitoring costs. Further details of the features of design alternative 7A are presented below.

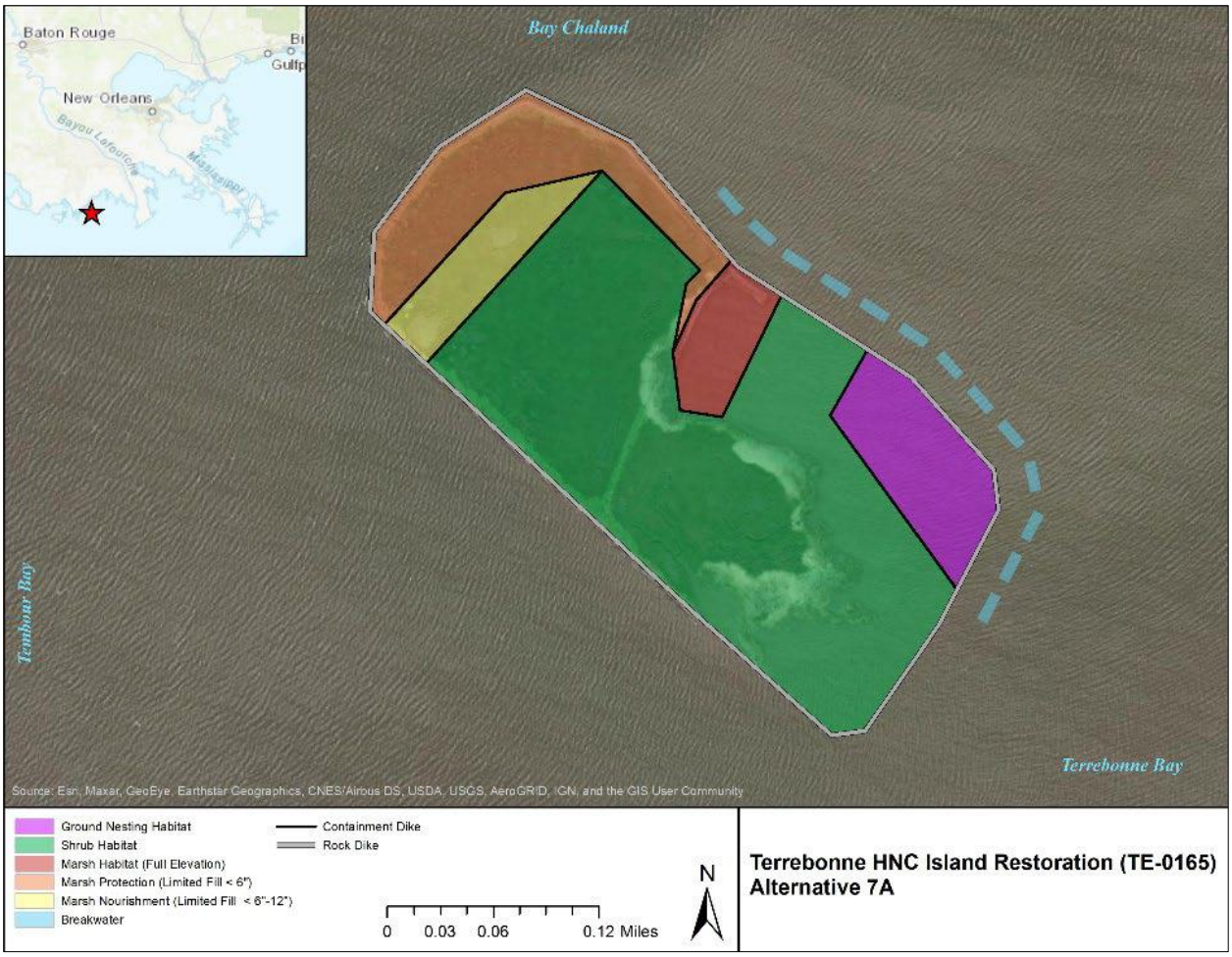

Figure 3-1. Features of Design Alternative 7A.

Table 3-1. Design Alternative 7A Habitat Acreage.

Habitat	Approximate Acreage
Ground Nesting	3.9
Shrub Nesting	27.0
Marsh	10.5
Total	41.4

3.1.1.1 Ground Nesting

Design alternative 7A is expected to result in approximately 3.9 acres of ground nesting habitat, which is expected to benefit terns, black skimmers (*Rynchops niger*), and laughing gulls (*Leucophaeus atricilla*). This habitat would contain no vegetation but instead consist of fine grade limestone (i.e., #8 limestone) and would be located on the northern side of the island inside the perimeter rock dike. Ground nesting habitat would be approximately 0.5 feet below the top of the rock dike, which would be constructed to an elevation of +5.0 feet and would remain above the 10% annual exceedance probability (AEP) to protect nests from flooding and wash out. Bird ramps would be incorporated to allow smaller birds access to the exterior of the island (see Section 3.1.1.6).

3.1.1.2 Shrub Nesting

Design alternative 7A is expected to result in approximately 27 acres of shrub nesting habitat. This habitat would be located across a significant portion of the current aerial extent of the island. The area is being designed to remain above the 10% AEP with a construction elevation range of +4.27 to +5.28 feet (including a 0.5 foot construction tolerance). Shrub nesting habitat is expected to benefit brown pelicans (*Pelecanus occidentalis*), herons, egrets, and white ibis (*Eudocimus albus*). Depending on site conditions after construction and availability of funding, this area might be planted.

3.1.1.3 Marsh

Design alternative 7A makes use of the island's existing features by creating three different marsh elevations: marsh protection (about 5.9 acres), marsh nourishment (about 2.6 acres), and marsh creation (full marsh habitat) (about 2 acres) to total approximately 10.5 acres of marsh. The full marsh habitat would be constructed to +2.5 to +4.78 feet; marsh nourishment would provide limited fill from 0.5 to 2.0 feet above grade transitioned to the adjacent habitat; and the marsh protection would consist of fill up to 0.5 feet above grade, leaving this area at a lower elevation relative to the rest of the island in order to provide healthy nesting habitat during construction. The three categories of marsh habitat would be constructed within the perimeter rock dike. Since the marsh protection area would be minimally disturbed, the existing mangroves would allow for continued nesting on the island, specifically for brown pelicans, and increase the potential for nesting success in the first years after construction. Tidal exchange would occur in marsh habitat via low points in the perimeter rock dike. Depending on site conditions post-construction and availability of funding, marsh plantings could include black mangroves (*Avicennia germinans*), smooth cordgrass (*Spartina alterniflora),* and marshhay cordgrass (*Spartina patens*). This habitat would benefit clapper rails (*Rallus crepitans*), seaside sparrow (*Ammodramus maritimus*), marsh wren (*Cistothorus palustris*), and mottled duck (*Anas fulvigula*) (ASCE, 2022a).

3.1.1.4 Rock Dike

Approximately 5,575 linear feet of rock dike would be refurbished and constructed around the perimeter of the island. The entirety of this rock dike would be constructed using 440-pound rock riprap. The dike is proposed to be built at two different elevations based on the following methodologies:

- Along the southeastern and western sides of the island in the submerged areas, as well as on the existing dike, the rock dike would be constructed to an elevation of +5.5 feet and would total approximately 3,700 linear feet. The inside slope would contain a geotextile separator fabric to prevent sediment from moving through the dike.
- Adjacent to the marsh protection habitat, roughly 1,875 linear feet of rock dike would be refurbished to an elevation of approximately +2.5 feet. This proposed rock dike would add an average of 2 feet to the existing rock dike in this area, which would allow for greater tidal exchange and increased nourishment to the marsh protection area that contains existing mangroves and would also promote further tidal exchange near the proposed marsh habitat. It would not include geotextile separator fabric.

3.1.1.5 Breakwaters

Breakwaters are being designed to provide additional protection to the island's planned tidal exchange areas. In these areas, the external rock dike would be reduced in height. In addition to providing protection, the breakwaters would provide calm water for loafing habitat as well as nursery habitat for a variety of aquatic fauna.

The total breakwater length could be up to approximately 1,688 linear feet, and the target construction elevation for the breakwaters would be finalized during project design. It would likely range from +3.5 to +5.5 feet and correlate to roughly 40% to 1% of waves overtopping the breakwaters, respectively. The same material used for the rock dike would be used for the breakwaters. The breakwaters would likely be placed between the -4.5- and -6.5-foot contours.

3.1.1.6 Bird Ramps

Design alternative 7A would incorporate bird ramps in areas where ground nesting and marsh protection habitats are adjacent to the rock dike. Additional rock quantity is also included to account for additional areas deemed critical. The bird ramps would be accomplished by filling voids in the rock dike with smaller rock (i.e., #1 limestone) and would allow small, flightless, ground nesting birds access to areas outside of the island without falling into those voids.

3.1.1.7 Borrow Area

Cat Island Pass is the planned borrow area for the project; it is located between Timbalier Island and Isles Dernieres and is approximately 10 miles south of the Terrebonne HNC Island Restoration project area. Water depth in the Cat Island Pass borrow area varies between 15 and 20 feet. Approximately 450,000 cubic yards of material would be required to be dredged from the borrow area to complete the habitat restoration.

3.1.1.8 Access Channels

For transport of equipment and rock riprap to Terrebonne HNC Island Restoration, the HNC would likely be the primary access route as the island is less than 1,000 feet east from the channel centerline. The HNC is an existing route used by barges to access Terrebonne Bay and is maintained to an approximate depth of 15 feet. Access around the perimeter of the island is needed for construction. An equipment access corridor/staging area has been designated around the project area on all sides. The equipment access corridor/staging width ranges from approximately 215 to 750 feet. Since the water depth in some areas is at or shallower than 5 to 6 feet (ELOS and RECON, 2022), investigation with industry leaders has indicated that the construction contractor may prefer to lightly load rock barges from full rock barges in the staging area as a least cost alternative to additional access dredging around the island.

3.1.2 Design Alternative 7

Design alternative 7 would include restoration of approximately 7.0 acres of ground nesting habitat, 36.0 acres of shrub nesting habitat, and 10.3 acres of marsh habitat in similar locations as the preferred alternative. Restoration across habitat types would increase the acreage of the island from 27.6 acres to approximately 53.3 acres (Table 3-2). Design alternative 7 would also include a perimeter rock dike (6,549 linear feet) and breakwaters (1,759 linear feet) on the southeastern side of the island. See Figure 2-1 for the habitat and shoreline protection layout for design alternative 7 and Table 3-2 for habitat acreage to be restored for design alternative 7. Dredged material from a borrow area near Cat Island Pass would be used for habitat restoration, and rock riprap would be used for the shoreline protection features. The access channels used for this design alternative would be the same as proposed for design alternative 7A. When compared to design alternative 7A, design alternative 7 would include an additional 11.9 acres of habitat, an additional 974 linear feet of rock dike, and an additional 71 linear feet of breakwaters.

Table 3-2. Design Alternative 7 Habitat Acreage.

Habitat	Approximate Acreage
Ground Nesting	7.0
Shrub Nesting	36.0
Marsh	10.3
Total	53.3

3.1.3 The LA TIG's Preferred Alternative and Summary Rationale

Design alternative 7A is the preferred alternative for the Terrebonne HNC Island Restoration project because it was the most cost-effective design alternative evaluated. Design alternative 7A provides ground nesting, shrub nesting, and marsh habitat for a variety of avian species over the 20-year life of the

project. It also provides additional protection of the island through construction of a perimeter rock dike and may include breakwaters on the northeast side of the island. Design alternative 7A provides a balance between constructability and creation of optimal habitat features for nesting birds, while minimizing environmental impacts during construction. It also provides varying elevations for avian nesting across the ground nesting, marsh, and shrub nesting habitats.

Although, recent cost increases associated with construction material and transport of that material to the project area required that the habitat restoration project features be scaled to fit within the available project budget, design alternative 7A fulfills the restoration approach of “create, restore, and enhance barrier and coastal islands and headlands” described in the Final PDARP/PEIS to address the DWH Oil Spill Trustees’ programmatic restoration goal to replenish and protect living coastal and marine resources.

4 NEPA Analysis

This chapter includes a description of the affected environment and an analysis of the environmental consequences for the Terrebonne HNC Island Restoration project design alternatives. To avoid or minimize the impacts of identified environmental consequences, the LA TIG would consider best practices referenced in PDARP/PEIS Section 6.15 and Appendix 6.A. For purposes of this document, the proposed action is considered implementation of the preferred alternative, design alternative 7A, for the Terrebonne HNC Island Restoration project. A non-preferred alternative and a no action alternative are also analyzed.

4.1 Introduction

To determine whether an action has the potential to result in significant impacts, the context and intensity of the action must be considered. Context refers to the area of impacts (e.g., local, statewide) and their duration (e.g., whether they are short- or long-term impacts). Intensity refers to the severity of an impact and could include the timing of the action (e.g., more intense impacts would occur during critical periods of high visitation or wildlife breeding/rearing). Intensity is also described in terms of whether the impact would be beneficial or adverse. For purposes of this document, impacts are characterized as minor, moderate, or major, and short-term or long-term.

"Adverse" is used in this chapter only to describe the federal Trustees' evaluation under NEPA. That term is defined and applied differently in consultations conducted pursuant to the Endangered Species Act (ESA) and other protected resource statutes. Accordingly, in the protected resources sections there may be adverse impacts 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 will be included in the DWH administrative record and Section 5.3 of this document.

In this chapter, the terms "impacts," "effects," and "consequences" are used interchangeably. Impacts were assessed in accordance with the guidelines in the Final PDARP/PEIS Table 6.3-2 (see Appendix B).

Table 4-1 lists the remaining sections within Chapter 4 and describes the content of each.

Table 4-1. Chapter 4 Section Content.

Section Number	Section Content
Section 4.2	Minimally affected resources common to the preferred and non-preferred design alternatives
Section 4.3	Resources analyzed in detail
Section 4.3.1	Affected environment by resource category
Section 4.3.2	Environmental consequences of the preferred alternative
Section 4.3.3	Environmental consequences of the non-preferred alternative
Section 4.3.4	Environmental consequences of the no action alternative
Section 4.3.5	Cumulative impacts

4.2 Minimally Affected Resources Common to the Preferred and Non-Preferred Design Alternatives

Design alternatives included in the reasonable range were reviewed to determine whether any resources would experience similar minor adverse impacts common to all alternatives, no impact, or negligible impacts not requiring detailed analysis. The subset of resource categories that experience no impacts to

minor adverse impacts similarly across the preferred and non-preferred alternatives are described in this section once rather than repeated throughout the sections applicable to each alternative.

Potential impacts to resources relevant to the Terrebonne HNC Island Restoration project design alternatives have been included in previous NEPA analyses for other bird island projects including the RP/EA #1.1 for Queen Bess Island (LA TIG, 2019) and RP/EA #3.3 for Rabbit Island (LA TIG, 2020a) and are incorporated by reference here and discussed below as appropriate. Documents other than these are cited individually as needed in the following sections. Each of these analyses concluded that resources would not be significantly adversely impacted by bird island restoration activities that are similar to or the same as those proposed for the Terrebonne HNC Island Restoration project (e.g., excavation of borrow material, transport of the borrow material along an access corridor, construction of containment dikes from in-situ materials, and filling open water or low elevation marsh areas with sediment to create habitat). These resources were subsequently identified as being minimally impacted by the proposed projects and are described briefly below, with the rationale for their elimination from further analysis. In addition, the Terrebonne HNC Island Restoration project design alternatives are not anticipated to contribute substantially to cumulative impacts and these resources are not analyzed in further detail in the cumulative impacts section.

4.2.1 Physical Environment

4.2.1.1 Air Quality

In accordance with the Clean Air Act of 1970 (as amended), the USEPA developed the National Ambient Air Quality Standards (NAAQS) that list six atmospheric pollutants considered harmful to public health. The six pollutants are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide. LDEQ is responsible for regulating and ensuring compliance with the Clean Air Act in Louisiana. For compliance purposes, geographic areas within the United States are classified as either in attainment or nonattainment for air quality. Geographic areas that have all six criteria pollutants below NAAQS are considered in attainment, whereas areas exceeding these levels are considered nonattainment areas. In nonattainment areas, USEPA requires states to develop and/or revise a state implementation plan to ensure the standards would be attained.

A qualitative analysis was completed for the Terrebonne HNC Island Restoration project. USEPA has determined that Terrebonne Parish is currently below NAAQS for all pollutants (USEPA, 2022a). Based on the USEPA report, Terrebonne Parish, where the project and borrow areas are located, has been below NAAQS for all pollutants since at least 1992. The Terrebonne HNC Island Restoration project area is uninhabited and only accessible by water or air. As a result, air pollution sources are limited to boat, helicopter, and seaplane traffic, and pollutants that are transported by winds to the project area. Potential sources of airborne pollutants include the limited development along and vehicular traffic on LA Highway 56 to the northwest of the project area and the Louisiana Land & Exploration Co., LLC facility located approximately 4 miles northwest of the project area. The closest major sources of air pollution occur in the urban-industrial corridor from New Orleans to Baton Rouge, which is approximately 55 miles north of the project area at the closest point and in St. Mary Parish, which is approximately 45 miles northwest of the project area.

Short-term, minor, adverse air quality impacts may occur during construction due to the dust and exhaust from equipment and earthwork activities. Additional effects may also arise from an increase in vessel use to deliver equipment, materials, and construction workers to the project area. These localized, temporary activities are not likely to increase any of the six primary pollutant levels above the NAAQS, even when considered cumulatively with other area emissions, nor would they have any measurable impact on greenhouse gas emissions. An increase in marsh vegetation could potentially provide a long-term benefit to air quality for the project areas; however, it would be difficult to measure.

4.2.1.2 Noise

The Final PDARP/PEIS (Chapter 6; DWH Trustees, 2016) states the primary sources of terrestrial noise in the coastal environment are transportation- and construction-related activities, which is consistent with the noise sources within the Terrebonne HNC Island Restoration project area. The primary sources of ambient (background) noise in the project area are boating vessels (recreational and commercial),

industrial operations, and natural sounds such as wind and wildlife. The closest residential land uses are along LA Highway 56 near Cocodrie, Louisiana, which is located just over 4 miles northwest of the project area. The closest industrial land use is the Louisiana Land & Exploration Co., LLC facility located approximately 4 miles northwest of the project area. The level of noise varies depending on the season, time of day, number and types of noise sources, and distance from the noise source.

Noise impacts associated with the project would be limited to construction activities and would be adverse, short-term, and negligible to minor, depending on proximity to those activities. The dominant noise sources from project construction elements are earth-moving and sediment-hauling activities as well as dredging and discharge of sediment from the dredge pipe. Minor noise impacts to wildlife would occur, but wildlife would avoid or temporarily relocate from the area during noise-generating activities.

4.2.2 Socioeconomic Resources

4.2.2.1 Socioeconomics and Environmental Justice

Approximately 109,580 people live in Terrebonne Parish where HNC Island is located. Over 30% of the population of the parish lives in Houma (U.S. Census Bureau, 2021a). The median household income in 2019 dollars was $48,446 (U.S. Census Bureau, 2020), and approximately 20% of the population is living below the poverty threshold (U.S. Census Bureau, 2020). Approximately 19% of the population is black or of African American descent, 6% is Native American, and 7% is Hispanic or Latino (U.S. Census Bureau, 2021b). Cocodrie is the closest village to the project area, located just over 4 miles to the northwest at its closest point. Cocodrie is located within Census Tract 12.02, which, according to the U.S. Census Bureau, had a population of 2,037 people in 2020 (U.S. Census Bureau, 2021b). The median household income was $44,219, and over 15% of the population was below the poverty level (U.S. Census Bureau, 2021b). Approximately 12% of the population identifies as a race other than White (U.S. Census Bureau, 2021b), and about 15% of the population is 65 years of age or older (U.S. Census Bureau, 2020). Three percent of the population has an undergraduate degree or higher (U.S. Census Bureau, 2020).

The Terrebonne HNC Island Restoration project is anticipated to benefit natural resources, and therefore socioeconomics and environmental justice, over the long term. However, during construction, activities involving construction equipment and commuting workers might increase boat traffic in localized areas resulting in short-term, negligible to minor, adverse impacts.

The project would result in short-term benefits to the local economy through an increase in employment and associated spending in the nearby areas during construction. The project could provide long-term benefits to commercial and recreational fishing industries through benefits to fish populations, in which case, direct and indirect benefits to the local economy would be longer term. Finally, the proposed project would have long-term benefits, in terms of reducing coastal erosion, consistent with one of the primary environmental justice goals for Louisiana (USEPA, 2016). The project would not likely create a disproportionately large or adverse effect on minority or low-income populations.

4.2.2.2 Infrastructure

The Terrebonne HNC Island Restoration project area is uninhabited and only accessible by water or air. There are no buildings or development directly on or adjacent to the project site. The project area is largely surrounded by open water, and the borrow area is in open water. Implementing the project would not impact infrastructure as both the project area and borrow area are undeveloped.

4.2.2.3 Land and Marine Management

The Federal Coastal Zone Management Act (CZMA) encourages states to develop coastal management programs for preserving statewide coastal resources. Once a state develops an approved coastal management program, “federal consistency” requires that any federal actions affecting coastal land or water resources (the Coastal Zone) be consistent with the state’s program. LDNR Office of Coastal Management (LDNR OCM) oversees the state’s Coastal Zone Management (CZM) Program. The Terrebonne HNC Island Restoration project is located within the Louisiana Coastal Zone established by the State and Local Coastal Resources Management Act of 1978, modified in 2012 (LDNR, 2012).

Terrebonne Parish has a Local CZM Program that was created by the Terrebonne Parish Council in 1997 (Terrebonne Parish CZMA Committee, 2000). The Terrebonne Parish CZM Program divided the parish into 13 environmental management units (EMU) (Terrebonne Parish CZMA Committee, 2000). The project and borrow area are located within the Terrebonne Marshes EMU. The program outlines strategies for this EMU that include bank stabilization, protection of shoreline, freshwater and sediment diversions, and restoration of deteriorating marsh (Terrebonne Parish CZMA Committee, 2000).

The Terrebonne HNC Island Restoration project could result in short-term, minor, adverse impacts to land and marine management due to temporary partial closure of areas, public access restrictions, and/or interruption of interpretive programs during construction (DWH Trustees, 2016). Removal of sediment from the Cat Island Pass borrow area is expected to result in short-term, negligible to minor, adverse impacts to land and marine management due to the additional traffic in and near the HNC required to deliver dredged sediment to the project area. Additional traffic in and near the HNC would be expected during delivery of rock riprap, equipment, and workers to the project area. However, the project would support the strategies outlined in the Parish's CZM Program (e.g., restoring marsh, stabilizing marsh islands, restoration of deteriorating marsh, etc.) and would result in long-term, beneficial impacts to land and marine management due to their aim of restoring nesting, loafing, and marsh habitats as well as providing shoreline protection via a perimeter rock dike and possibly breakwaters. All proposed improvements would conform to the requirements set forth in the Parish CZM Program and are consistent with the strategies for the EMUs.

4.2.2.4 Tourism and Recreational Use

The area surrounding the Terrebonne HNC Island Restoration project area is a popular destination for boating, birdwatching, fishing, and other recreational activities. The project area is accessible by water or air. Most of the homes nearest the project area are fishing and hunting camps; the population of the area swells during the height of the fishing and hunting seasons. Many full-time residents of the area make their living off the commercial fishing of oysters, crab, shrimp, and fish as well as charter fishing businesses.

Because the Terrebonne HNC Island Restoration project area is accessible only by boat or air and because it is privately owned, tourism and recreational use of the island by the general public would not be affected. State law currently prohibits the creation of public rights over private property based solely on the expenditure of funds for integrated coastal protection projects. The project could result in short-term, minor, adverse impacts to tourism and recreational use if construction activities discourage or prohibit visitors. In the long term, the project would likely serve to enhance recreational opportunities including boating, birdwatching, fishing, and wildlife viewing experiences. Removal of sediment from the Cat Island Pass borrow area should not result in impacts to tourism and recreational use as similar activities occur at or near the site during routine maintenance dredging activities and are not disruptive.

4.2.2.5 Aesthetics and Visual Resources

The primary visual features in the Terrebonne HNC Island Restoration project area include marshes, shallow open waters, open bays, and vessel traffic in the HNC and surrounding bays. Habitats surrounding the project area support recreational opportunities such as wildlife observation (e.g., bird watching), boating, and recreational fishing as well as commercial fishing and charter fishing.

There would be a short-term, minor, adverse impacts from the presence of heavy equipment in the project area during construction. The project would result in long-term beneficial impacts to aesthetics and visual resources as it would serve to restore marshes, shrub nesting, and ground nesting habitat which in turn would increase wildlife, thereby enhancing the natural aesthetics and visual resources of the area.

No impacts to aesthetics and visual resources are anticipated as a result of removal of sediment from the Cat Island Pass borrow area. Dredging activities occur regularly in Louisiana's passes.

4.2.2.6 Public Health and Safety

The Terrebonne HNC Island Restoration project would be constructed on private, uninhabited land. Open water adjacent to the project area is state claimed water bodies and currently open to the public for

recreational and commercial activities (LDNR, n.d.). The area is remote and uninhabited. The Delta Shipyard in Houma is on the National Priorities List (NPL) (USEPA, 2022b); it is over 25 miles north of the project area. The Cat Island Pass borrow area is in waters approximately 10 miles south of the project area.

The project would result in long-term, beneficial effects to public health and safety through the restoration of the island footprint, shoreline protection features, and resulting reductions in wave action and increases in island elevation. The project would not adversely impact public health and safety, and there are no NPL sites near the project or borrow area. The project would comply with Executive Order (EO) 13045, Protection of Children from Environmental Health Risks and Safety Risks and does not represent disproportionately high and adverse environmental health or safety risks to children in the United States. Implementation of the project would not create other health and safety concerns. All U.S. Coast Guard rules and state/federal laws would be followed during construction, and construction activities would be conducted to avoid, to the greatest extent feasible, any unreasonable interference with public health and safety.

4.2.2.7 Fisheries and Aquaculture

Terrebonne Parish, which means “Good Earth,” has an abundance of seafood, wildlife, and natural resources and is open to recreational and commercial fishing. Oyster, shrimp, crab, and fish are the major seafood contributors to the economy. There are no oyster leases in the Terrebonne HNC Island Restoration project or Cat Island Pass borrow area; however, there are numerous leases north of the project area (LDWF, n.d.-a). One lease may be impacted by turbidity resulting from construction activities. When compared to other parishes, Terrebonne Parish had the second highest average annual volume of oysters landed between 2000 and 2009 (3.2 million pounds), valued at $7.1 million per year (LDWF, 2011). No aquaculture is known to occur in either the project or borrow area.

During construction, the project could result in a temporary decline in fisheries near the project and borrow areas due to relocation away from construction activities, resulting in a short-term, minor, adverse impact. However, they are expected to return once construction activities have concluded. These short-term impacts would be offset by long-term, beneficial impacts on fisheries generated by the expansion of marsh habitat and tidal exchange points located on the northern side of the island. Dredged material would be fully contained within the project area through use of hay bales as internal containment dikes and the perimeter rock dike. Due to turbidity near the project area during construction, an oyster lease would be acquired via the oyster lease acquisition and compensation program (OLACP; Louisiana Revised Statute [La. Rev. Stat.] § 56:432.1). No long-term impacts to other fisheries in the area are anticipated as a result of project implementation.

4.2.2.8 Marine Transportation

Navigation channels used by recreational and commercial vessels near the Terrebonne HNC Island Restoration project and borrow areas include the HNC, Little Caillou Bayou, Cat Island Pass, Terrebonne Bay, and Bayou Terrebonne. The HNC would be used for access of the dredge to the Cat Island Pass borrow area; access of the pipeline from the borrow area to the project area; and access for personnel, supplies, and equipment from Cocodrie to the project and borrow areas.

During construction, the project could result in short-term, minor, adverse impacts to marine transportation, but they would not unreasonably interfere with or create obstructions to navigation on the surrounding waterways. Construction activities would be conducted to avoid, to the greatest extent feasible, any unreasonable interference with navigation of marine transportation.

4.3 Resources Analyzed in Detail

The differences between the preferred and non-preferred alternative for the Terrebonne HNC Island Restoration project are a matter of scale for each habitat type restored (e.g., acres of shrub nesting habitat restored), geographic footprint of the various habitat types restored (e.g., location of ground nesting habitat), or the extent of shoreline protection features implemented (e.g., linear footage and location of breakwaters constructed). Consequently, impacts across alternatives differ minimally and are described in the sections below.

4.3.1 Affected Environment

Physical, biological, and socioeconomic resources within the Terrebonne Basin and the Terrebonne HNC Island Restoration project area are discussed in the remainder of this section.

4.3.1.1 Physical Environment

4.3.1.1.1 Geology and Substrates

The Terrebonne HNC Island Restoration project would benefit an existing coastal marsh island located on the eastern side of the HNC within the Terrebonne Basin. The Terrebonne Basin lies within the Lafourche lobe of the historic Mississippi River distributary system, which was the active lobe of the Mississippi River Delta between approximately 1,000-300 years ago. Sedimentation in this area has declined since the Mississippi River began migrating to its current position along the Bird's Foot Delta approximately 750 years ago (Day et al., 2007). Reductions in sedimentation and freshwater inputs, excavation of oil and gas canals, and natural processes such as sea level rise, subsidence, and extreme storm events have resulted in coastal erosion and saltwater intrusion throughout the Terrebonne Basin.

The sediments within the project area are characterized by gray to black clays with high organic content, including some peat (Snead and McCulloh, 1984). Surface soils in the project area have been classified by the USDA Natural Resources Conservation Service (NRCS) as primarily scatlake muck with 0 to 0.2 percent slopes. The soils are very poorly drained, have negligible runoff, are very frequently flooded, and are frequently ponded, which is typical of coastal marshes (USDA NRCS, 2019).

The Cat Island Pass borrow area would be hydraulically dredged to provide sediment for the Terrebonne HNC Island Restoration project. The project is expected to require a 24-30-inch, direct-line dredge. The hydraulic dredge pipeline is anticipated to be approximately 10 miles long and require one to two booster pumps for the material being pumped. Geotechnical borings indicate that there is a sand layer of approximately 20 feet within the designated 60-acre borrow area.

4.3.1.1.2 Hydrology and Water Quality

Previous water quality inventory reports have found minor water quality problems in the Terrebonne Basin, with suspected sources of these problems listed as non-irrigated crop production, pastureland, urban runoff, hydromodification, combined sewers, unsewered areas, surface runoff, and spills (LDWF, 2005). LDEQ monitors surface water and groundwater water quality. Surface water management seeks to protect the quality of all waters throughout the state, including rivers, streams, bayous, lakes, reservoirs, wetlands, estuaries, and many other types of surface water. LDEQ issues a biennial integrated report of the status of Louisiana waters. LDEQ defines eight designated uses for surface waters: primary contact recreation (swimming), secondary contact recreation (boating), fish and wildlife propagation, drinking water supply, shellfish propagation, agriculture, outstanding natural resource waters, and limited aquatic and wildlife use (LDEQ, 2020). Each water body is evaluated as fully supporting, partially supporting, or not supporting of each of its designated use(s).

Based on the Final 2020 Louisiana Water Quality Integrated Report (LDEQ, 2020), the Terrebonne HNC Island Restoration project area and Cat Island Pass borrow area are in the Terrebonne Bay estuarine subsegment (LA120802), which is listed as not fully supporting the designated use for primary contact recreation but fully supporting the designated use for secondary contact recreation, fish and wildlife propagation, and oyster propagation. The suspected cause of impairment for primary contact recreation is enterococcus (bacteria that indicate possible contamination of water bodies by fecal waste).

The project area is located within the Federal Emergency Management Agency (FEMA)-designated Flood Zone V21, which is subject to inundation by the 1-percent-annual chance flood event, with additional hazards due to storm-induced velocity wave action (FEMA Panel ID: 225206200C). The Flood Insurance Rate Map (FIRM) is accessible via the following URL: https://msc.fema.gov/portal/viewProduct?productID=2252060200C. Base flood elevations of the 1-percent-annual-chance flood have been determined. The date of the effective FIRM is May 1, 1985.

4.3.1.2 Biological Environment

4.3.1.2.1 Habitats

The project area consists of low-elevation emergent marshes and open water partially surrounded on the north and west sides with a rock dike. Mean low water and mean high water were determined to be 0.30 feet and 1.08 feet, respectively. Emergent marshes in the project area range in elevation from +0.34 feet to +2.00 feet. The existing rock dike ranges in elevation from +1.49 feet to +4.0 feet. Water depth in the Cat Island Pass borrow area varies between 15 and 20 feet.

From 2006 to 2021, emergent marshes near the project area were classified as saline (USGS, n.d.). Coastwide Reference Monitoring System (CRMS) Site 0347 is just over 5 miles southwest of the project area, and marsh species classified at the site in 2021 included smooth cordgrass and black mangrove. The Floristic Quality Index, used to determine wetland quality based on plant species composition, has been above the 60th percentile for all years. CRMS Site 0355 is over 8 miles northeast of the project area; emergent marsh at the site has been classified as saline for all years between 2006 and 2021 except 2017. The dominant species at the site was classified as smooth cordgrass.

Saline marshes are polyhaline marshes that undergo regular tidal flooding and are dominated by salt-tolerant grasses. Plant diversity and soil organic matter content are relatively low in saline marshes when compared to other marsh types (Holcomb et al., 2015). Saline marshes provide important nesting, brood-rearing, and foraging habitat for various bird species, including migratory birds and colonial nesting waterbirds. Emergent marshes are also important nursery habitats for larval fish, crustaceans, and aquatic invertebrates. Benthic and epiphytic algae are also important producers in emergent marsh habitats (LDWF, 2005; Holcomb et al., 2015).

4.3.1.2.2 Wildlife Species

Many wildlife species, including numerous bird species, mammals, reptiles, and amphibians, use marsh, open water, and higher elevation habitats within marshes near the project area (CWPPRA, 1993). The Terrebonne Basin provides wintering habitat for many species of waterfowl. HNC Island is one of the last remaining colonial waterbird nesting colonies in Louisiana, and colonial waterbirds that nest on the island include brown pelicans, herons, egrets, and white ibis among others.

More than 38 species of birds have been documented at one ebird Hotspot site near the project area (refer to website at the following URL: https://ebird.org/hotspot/L964600). These species include but are not limited to gulls, terns, pelicans, herons, egrets, swallows, warblers, ducks, skimmers, and sandpipers. Multiple bird species observed near the project area are listed as birds of conservation concern by the U.S. Fish and Wildlife Service (USFWS) for Terrebonne Parish, including the black skimmer and willet (*Tringa semipalmata*). These species represent the highest conservation priorities of USFWS beyond those currently designated as threatened or endangered (USFWS, 2021a). All migratory bird species are protected under the Migratory Bird Treaty Act (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.).

4.3.1.2.3 Marine and Estuarine Aquatic Fauna, EFH, and Managed Fish Species

The water bodies and emergent marshes within and in the vicinity of the project area provide essential nursery and foraging habitats supportive of a variety of aquatic fauna. Additionally, the marshes and open waters in and near the project area provide habitat for species that support recreational fishing, which is important culturally and economically.

Under the Magnuson-Stevens Act, regional fishery management councils and NOAA's National Marine Fisheries Service (NMFS) designate essential fish habitat (EFH) in fishery management plans for all federally managed fisheries. The Gulf of Mexico Fishery Management Council (GMFMC) manages over 40 species (GMFMC, 2005) and has developed five EFH "eco-regions" to refine their designations. Within each eco-region, EFH was further defined as occurring either in estuarine (inside barrier islands and estuaries), nearshore (less than 18 meters or 59 feet deep), or offshore waters (greater than 18 meters or 59 feet deep). The project and borrow areas are in the estuarine and nearshore waters of Eco-region 4, respectively, which extends from Freeport, Texas, east to the Mississippi River Delta. In estuarine habitats, EFH has been designated for six GMFMC-managed species of fishes and crustaceans (Table 4-2). In nearshore habitats, EFH has been designated for 12 GMFMC-managed species of fishes and

crustaceans (Table 4-3). Additionally, NMFS manages highly migratory species for which EFH has been designated based on distribution data rather than habitat type and includes five species of sharks in or near the project area (Table 4-4).

Table 4-2. EFH Requirements for Managed Species that Occur in Estuarine Habitats within the Project Area.

Species	**Life Stage(s)**	**EFH**
Red drum (*Sciaenops ocellatus)*	Larvae	Estuarine submerged aquatic vegetation (SAV), estuarine mud/soft bottom
Red drum	Post larvae/adult	Estuarine emergent marsh, estuarine SAV, estuarine sand and shell bottom, estuarine mud/soft bottom
Red drum	Early juvenile	Estuarine emergent marsh, estuarine mud/soft bottom
Red drum	Late juvenile	Estuarine SAV
Gray snapper *(Lutjanus griseus)*	Adult	Estuarine emergent marsh, estuarine sand and shell bottom, estuarine mud/soft bottom
Lane snapper *(Lutjanus synagris)*	Post larvae	Estuarine SAV
Lane snapper	Early juvenile/late juvenile	Mangrove, estuarine SAV, estuarine sand and shell bottom, estuarine mud/soft bottom
Gray triggerfish *(Balistes capriscus)*	Early juvenile	Mangrove
Brown shrimp *(Farfantepenaeus aztecus)*	Early juvenile	Estuarine emergent marsh, estuarine SAV, estuarine oyster reef, estuarine sand and shell bottom, estuarine mud/soft bottom
White shrimp *(Litopenaeus setiferus)*	Early juvenile	Estuarine emergent marsh, estuarine mud/soft bottom

Table 4-3. EFH Requirements for Managed Species that Occur in Nearshore Habitats within the Borrow Area.

Species	**Life Stage(s)**	**EFH**
Lane snapper (*Lutjanus synagris*)	Post larvae/early juvenile/late juvenile	Nearshore SAV
Lane snapper	Early juvenile/late juvenile/adult	Nearshore sand/shell bottom
Lane snapper	Early juvenile/late juvenile	Nearshore mud/soft bottom
Lane snapper	Adult	Nearshore shoal/banks
Lane snapper	Post larvae/early juvenile/late juvenile/adult	Nearshore reefs
Red drum (*Sciaenops ocellatus)*	Late juvenile/adult	Nearshore hardbottom, nearshore sand/shell bottom

Species	Life Stage(s)	EFH
Red drum	Eggs/adult	Nearshore pelagic
Gray snapper *(Lutjanus griseus)*	Adult	Nearshore hardbottom, nearshore sand/shell bottom, nearshore mud/soft bottom
Gray snapper	Spawning adult	Nearshore shoal/banks
Gray snapper	Adult/spawning adult	Nearshore reefs
Red snapper (*Lutjanus campechanus*)	Early juvenile	Nearshore hardbottom, nearshore mud/soft bottom
Red snapper	Adult	Nearshore sand/shell bottom
Red snapper	Larvae	Nearshore pelagic
Vermilion snapper (*Rhomboplites aurorubens*)	Early juvenile/late juvenile	Nearshore hardbottom, nearshore reefs
Gray triggerfish *(Balistes capriscus)*	Adult/spawning adult	Nearshore sand/shell bottom
Gray triggerfish	Late juvenile/adult/spawning adult	Nearshore reefs
Gray triggerfish	Larvae/post larvae/early juvenile/late juvenile	Nearshore drift algae (*Sargassum)*
Brown shrimp *(Farfantepenaeus aztecus)*	Adult	Nearshore sand/shell bottom, nearshore mud/soft bottom
White shrimp *(Litopenaeus setiferus)*	Eggs	Nearshore sand/shell bottom
White shrimp	Eggs/adult/spawning adult	Nearshore mud/soft bottom
White shrimp	Larvae	Nearshore pelagic
Cobia (*Rachycentron canadum*)	Eggs/Post larvae/early juvenile/late juvenile/adult/spawning adult	Nearshore pelagic
King Mackerel (*Scomberomorus cavalla*)	Early juvenile/late juvenile	Nearshore pelagic
Greater Amberjack (*Seriola dumerili*)	Adult	Nearshore pelagic
Greater Amberjack	Early juvenile/late juvenile	Nearshore drift algae (*Sargassum)*
Almaco Jack (*Seriola rivoliana*)	Early juvenile/late juvenile	Nearshore drift algae (*Sargassum)*

Table 4-4. Highly Migratory Species EFH Designations, State Waters of Eco-region 4, Terrebonne Basin.

Species	Life Stage(s)
Blacktip shark *(Carcharhinus limbatus)*	Neonate, juvenile, adult
Bull shark *(Carcharhinus leucas)*	Neonate, juvenile
Spinner shark *(Carcharhinus brevipinna)*	Neonate, juvenile
Atlantic sharpnose shark *(Rhizoprionodon terraenovae)*	Neonate, juvenile, adult
Scalloped hammerhead shark *(Sphyrna lewini)*	Neonate

4.3.1.2.4 Protected Species

A list of federally threatened and endangered species and other species of special concern with the potential to occur within Terrebonne Parish was developed based on the USFWS Information for Planning and Consultation (IPaC) resource list (USFWS, 2021b) (Table 4-5). Of the ESA-listed species potentially occurring in Terrebonne Parish, only the West Indian manatee *(Trichechus manatus)* potentially occurs in the project and borrow areas.

Table 4-5. Protected Species under the Endangered Species Act with the Potential to Occur within Terrebonne Parish.

Species	Status
West Indian manatee *(Trichechus manatus)*	Threatened
Eastern black rail (*Laterallus jamaicensis ssp. Jamaicensis*)	Threatened (presence unlikely)
Piping plover *(Charadrius melodus)*	Threatened (presence unlikely)
Red knot (*Calidris canutus rufa*)	Threatened (presence unlikely)
Alligator snapping turtle (*Macrochelys temminckii*)	Threatened (proposed; presence unlikely)
Hawksbill sea turtle *(Eretmochelys imbricate)*	Endangered (presence unlikely)
Kemp's ridley sea turtle *(Lepidochelys kempii)*	Endangered (presence unlikely)
Leatherback sea turtle *(Dermochelys coriacea)*	Endangered (presence unlikely)
Loggerhead sea turtle *(Caretta caretta)*	Threatened (presence unlikely)
Pallid sturgeon *(Scaphirhynchus albus)*	Endangered (presence unlikely)

Marine Mammals

The shallow waters within and just outside of the project and borrow areas may be accessible to protected aquatic mammals such as the federally threatened West Indian manatee. The marine borrow area may contain other marine mammals that are protected under the Marine Mammal Protection Act, like the bottlenose dolphin.

Turtles

Four protected sea turtle species are listed for Terrebonne Parish; however, none of these species are listed for the project area or borrow area. The hawksbill sea turtle (NOAA, n.d.-a) and leatherback sea turtle (NOAA, n.d.-c) are rarely observed in coastal Louisiana as it lacks the coral reef habitat preferred by the hawskbill sea turtle and coastal waters are too shallow for the leatherback sea turtle. The loggerhead

sea turtle is the most abundant species of sea turtle found in U.S. Atlantic coastal waters (NOAA, n.d.-d). It is a turtle of deep open water and is also known to frequent marshes, estuaries, and coastal rivers. This species requires beaches for nesting, and the closest documented nesting for loggerhead sea turtles is on the Chandeleur Islands, which are over 100 miles east of the project area (LDWF, n.d.-c). The Kemp's ridley turtle is found primarily in the Gulf of Mexico and prefers sheltered areas along the coast (NOAA, n.d.-b), such as bays and estuaries, and does not nest in Louisiana (LDWF, n.d.-b). The four sea turtle species are not known to nest in the project area, which lacks suitable beach-nesting habitat. Reports of sea turtle strandings in Terrebonne Parish are infrequent; of the listed species, most strandings involve Kemp's ridley sea turtles (NOAA, 2021b).

The alligator snapping turtle is proposed for listing as threatened in Louisiana; the species is known to inhabit freshwater geographies, such as large rivers and major tributaries (USFWS, 2022). Their range does not extend into the saline marshes of the Terrebonne HNC Island Restoration project area (USFWS, 2022).

Avian Species

The federally threatened piping plover, red knot, and eastern black rail may occur in portions of Terrebonne Parish; however, they are not listed for the project area. The project area lacks the wide, flat, sparsely vegetated mainland and barrier island beaches, sand spits, sandbars, and bayside flats that the piping plover and red knot prefer and the dense overhead cover preferred by the eastern black rail. Louisiana has few documented occurrences of eastern black rail, and these occurrences are concentrated in and around southwest Louisiana. Louisiana does not have a history of supporting eastern black rails consistently and is considered to be on the peripheries of known breeding areas (DOI, 2020). It is not likely that the eastern black rail would be found in the project area.

Designated critical habitat for the piping plover exists on barrier islands south of the project area (USFWS, 2015). Piping plovers reside in Louisiana up to ten months of the year, from July through mid-May (USFWS, 2015). During this time, they are dependent on foraging and roosting areas along sand beaches within the intertidal zone (USFWS, 2015). Red knots migrate annually between the Canadian Arctic, where they breed, and wintering regions including the Gulf of Mexico; migration usually begins in mid-July (USFWS, 2020). Wintering habitat for red knots typically consists of sandy, gravel, or cobble beaches, tidal mudflats, salt marshes, shallow coastal impoundments and lagoons, and peat banks (USFWS, 2020). Eastern black rails are wetland dependent and require dense overhead cover and moist to saturated soils interspersed with or adjacent to very shallow water (USFWS, 2019). Egg laying and incubation typically occurs between May and August. Adults undergo a post-breeding molt during July and September and are unable to fly for approximately three weeks (USFWS, 2019).

Pallid Sturgeon

The pallid sturgeon is known to inhabit the lower reaches of the Mississippi River; however, it is a bottom-oriented, large river obligate fish and are unlikely to occur in the project and borrow areas (USFWS, 2014).

4.3.1.3 Socioeconomic Resources

4.3.1.3.1 Cultural Resources

Cultural resources are evidence of past human activity. These may include pioneer homes, buildings, or old roads; structures with unique architecture; prehistoric village sites; historic or prehistoric artifacts or objects; rock inscriptions; human burial sites; or earthworks, such as battlefield entrenchments, prehistoric canals, or mounds. The Louisiana Office of Cultural Development, Division of Archaeology maintains an online geographic information system that shows both standing structures and archaeological sites in Louisiana. There are no known standing structures or archaeological sites within or near the Terrebonne HNC Island Restoration project and borrow areas (Louisiana Office of Cultural Development, n.d.). ELOS Environmental (ELOS) and RECON Offshore (RECON) conducted a submerged Phase I Cultural Resources survey of the access channel and proposed borrow area (ELOS and RECON, 2022). Per the survey report, there were 27 magnetic anomalies and nine sub-bottom profiler channel reflectors identified within the access channel. However, these isolated magnetic anomalies likely represent modern debris and not potentially significant submerged cultural resources. Additionally, there were 33 magnetic

anomalies, four side-scan sonar contacts, and three sub-bottom profiler channel reflectors identified in the proposed borrow area. None of the magnetic anomalies or side-scan sonar contacts represent potentially significant cultural resources. No high probability landforms associated with archaeological sites were associated with the access channel or borrow area.

A terrestrial cultural resources survey of the island is not required since the project area was cleared previously for use as a disposal site for material dredged from the HNC.

4.3.2 Environmental Consequences – Design Alternative 7A

4.3.2.1 Physical Environment

4.3.2.1.1 Geology and Substrates

Short-term, minor, adverse impacts to substrates, such as localized soil disturbances and compaction, could result from the use of heavy equipment during site preparation and project implementation. These impacts would be localized to small areas. It has not yet been determined whether staging areas for construction equipment and materials would be near the island or on the mainland. Should staging occur near the island, it would likely occur from barges within the equipment access corridor. The implementation of construction BMPs would help to minimize the impacts of construction. BMPs could include the implementation of erosion controls, installation of silt curtains to minimize turbidity, development of and adherence to a stormwater management plan, and ongoing construction monitoring.

The project would involve placing dredged material (i.e., silty sand) at various elevations to create marsh, shrub nesting, and ground nesting habitats. The project area currently includes these habitat types as well as shallow open water for loafing. The rock dike in the southern cell would likely be constructed first since that area requires the greatest amount of rock. Fill placement is anticipated in the submerged areas first since more than one layer of material and wait times between layers might be needed to achieve the final elevation. Once the majority of the dredged material is placed within the island footprint and has dewatered, final grading would take place to reach the required construction elevations. The placement of dredged material across the island would constitute a short-term, minor, adverse impact to existing substrates. However, the project area and surrounding access corridor has been impacted previously since it was used as a disposal site for material dredged from the HNC by the U.S. Army Corps of Engineers (USACE) over the past 20 years. CPRA has successfully implemented numerous barrier island and marsh island projects where dredged material was placed over existing sandy substrates. More detail on successful projects can be accessed at the following URL: https://cims.coastal.la.gov/outreach/projects/.

Implementation of the project would expand the island's footprint and thus habitat acreage. It is anticipated that vegetation, consisting of native species such as mangroves, matrimony vine (*Lycium halifolium*), marsh elder (*Iva annua*), and groundsel bush (*Baccharis halimifolia*) would either germinate naturally or be planted following construction as funding allows. This vegetation would provide a long-term benefit because it would help stabilize soils and reduce soil loss due to erosion (e.g., hydraulic scour and aeolian transport) in the long term.

The installation of shoreline protection features (i.e., perimeter rock dike and possibly breakwaters) would result in localized compaction and sediment disturbance. Because a perimeter rock dike was previously constructed, this component of the proposed project essentially constitutes maintenance of an existing feature. Construction of breakwaters outside of the perimeter rock dike would constitute a long-term, moderate, adverse impact to existing substrates; however, these features would protect the island from waves, reduce shoreline erosion, and increase the longevity of the island. Overall, the project would have a long-term, beneficial impact on geology and substrates in the project area as it would result in higher substrate elevations and reduced erosion, thereby increasing the resiliency of the island.

No long-term impacts are anticipated for the Cat Island Pass borrow area. The net transport of sediment along Timbalier Island is toward Cat Island Pass (Rosati and Lawton, 2011), so the borrow area is expected to refill naturally over time.

4.3.2.1.2 Hydrology and Water Quality

During construction, short-term, minor, adverse impacts to water quality in or near the island restoration area are expected. Localized erosion and sediment transport are expected during dredged material placement. The use of barges, other vehicles, and equipment during implementation and monitoring could also result in short-term, minor, adverse impacts to water quality due to potential fuel leaks or vehicle fluid leaks. Establishment of and adherence to BMPs during construction should minimize water quality impacts. Due to the re-establishment of the perimeter rock dike and construction of earthen containment dikes to contain sediment, most of the dredged material should be contained within the marsh and shrub habitats, which would limit runoff and sedimentation into adjacent waters.

Placing sediment to elevate the marsh level to that of healthy marsh in the area would alter the surface hydrologic conditions. Avenues for tidal exchange would be incorporated into project design. Water level inundation for marsh would range from 10-65%. Shrub and ground nesting habitats would be at sufficient elevation that the water level exceedance should be less than 10%. Therefore, the project would result in long-term, moderate beneficial impacts to hydrology.

Prior to construction, Storm Water Pollution Prevention Plans would be prepared, as necessary, in conjunction with the National Pollutant Discharge Elimination System permitting process. These plans would include all specifications and BMPs necessary for control of erosion and sedimentation due to construction-related activities and could include plantings, possible seeding, and installation of silt curtains where needed. The construction BMPs, and other avoidance and mitigation measures as required by state and federal regulatory agencies, would minimize water quality and hydrology impacts.

The project is likely to result in long-term benefits to hydrology and water quality. The establishment of vegetation would benefit hydrology and water quality by stabilizing soils which would protect the shoreline and reduce erosion. Water quality benefits would come, in part, from nutrient uptake within the restored marsh and shrub habitats.

Removal of sediment from the Cat Island Pass borrow area is not expected to impact hydrology but may temporarily increase turbidity in the vicinity of dredging operations both at the borrow area and the project area.

4.3.2.2 Biological Environment

4.3.2.2.1 Habitats

There would be some short-term, minor, adverse impacts to existing habitats associated with construction activities including site preparation and materials staging, if required, and during dredged material placement. The use of boats, construction machinery (e.g., hydraulic dredge, booster pumps, steel pipeline, barges, etc.), and other heavy equipment (e.g., cranes, excavators, bulldozers, and marsh buggies) within and around marshes may result in short-term, minor, adverse impacts to nesting and marsh habitats due to localized soil and sediment disturbances from possible vehicle fuel and fluid leaks. More details on these potential impacts will be available as E&D progresses. Some of the current open water areas would be filled with dredged material to create elevated nesting and marsh habitats. Filling these intertidal habitats would constitute a short-term, minor to moderate, adverse impact to those affected habitats.

Dredging would have adverse impacts on habitats within and adjacent to the borrow area. Short-term, minor, adverse impacts would occur in the aquatic habitats in these areas as there would be temporary local disturbances from dredging equipment and increased vehicle traffic along the access route. Short-term, moderate, adverse impacts would occur in benthic habitats that are actively dredged, or in which dredge pipelines are laid, as well as where the new rock dike and rock breakwater features are implemented. BMPs would be implemented as necessary to minimize impacts during construction.

Impacts to one oyster lease are anticipated as a result of project construction. When impacts are unavoidable, they would be mitigated by performing an oyster assessment to determine a fair purchase price, and then the leases would be purchased and extinguished via the OLACP.

If required, post-construction monitoring protocols for the project area would be developed during the permitting phase. Any required permit conditions and monitoring programs would be designed to reduce the adverse impacts of the project on terrestrial, aquatic, and benthic habitats.

The project would involve restoration of ground nesting, shrub nesting, and marsh habitats through the placement of dredged material from the Cat Island Pass borrow area. Creation of ground nesting habitat would benefit terns, black skimmers, and laughing gulls. Creation of shrub nesting habitat would increase the availability of upland habitat in the project area and would benefit brown pelicans, herons, egrets, and white ibis. Marsh creation, nourishment, and protection would benefit clapper rails, seaside sparrows, marsh wrens, and mottled ducks. Overall, the habitat restoration component of the project would increase the quantity and quality of these habitats. In addition, the increase in elevation of the island would reduce long-term susceptibility of the island and its habitats to storm overtopping and flooding, subsidence, and sea level rise. The shoreline protection component of the project would reduce the wave energy to which the island is subjected, which would also prolong the life of the island. Therefore, the project would provide long-term, beneficial impacts through creation and preservation of ground nesting, shrub nesting, and marsh habitats. The breakwaters would reduce erosive wave action on both the shoreline protection rock dike and the marsh habitat around the tidal exchange locations of the island. In addition, the breakwaters would create protected areas of water parallel to the shoreline, which would provide loafing areas for birds and nursery habitat for a variety of aquatic fauna.

4.3.2.2.2 Wildlife Species

The project would create short-term, minor, temporary displacement of birds and other wildlife during construction in the project area and in the borrow area. However, these impacts would be short-term, and suitable habitats are available nearby. Birds would need to find other areas to forage and loaf during this time (and mammals, reptiles, and amphibians, if present) would move to avoid construction activity and contact with workers. Following the restoration, wildlife would return quickly to the newly unoccupied habitat. Impacts to nesting, foraging, and overwintering habitats resulting from construction would be short-term, moderate, and adverse. BMPs would be implemented to minimize impacts to wildlife through identification and avoidance.

The project would result in long-term, beneficial effects to bird species that use the project area. While creating marsh and ground nesting habitat comes at the expense of losing open water habitat, the restored area would provide habitat (continuously being lost in this area due to subsidence, sea level rise, and wave action) for birds, mammals, reptiles, and amphibians that require higher elevations for portions of their life cycle. These benefits are important for feeding, nesting, and roosting needs of migratory and non-migratory bird species.

4.3.2.2.3 Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms), EFH, and Managed Fish Species

The project would have some short- and long-term, moderate, adverse impacts to aquatic fauna, fisheries, and EFH associated with conversion of open water habitats to ground and shrub nesting and marsh habitats, and conversion of marsh habitats to shrub nesting habitats. Increasing elevation at these locations would impact these habitats over the long-term via construction activities and the placement of dredged material or limestone. However, in many cases, existing aquatic habitat was previously wetland habitat that has degraded over time due to subsidence, sea level rise, and other factors. Additionally, EFH habitat that is impacted by project implementation would return over time as island elevations subside naturally. Mobile aquatic fauna disturbed and displaced in these areas would likely find refuge in nearby suitable habitats and then return to the project area after construction. Project construction may result in some disturbance to a nearby oyster lease as discussed previously.

Ultimately, there would be a net benefit for those species that depend on marsh habitats. The project would increase the overall quality of marsh habitat, which would provide long-term benefits to aquatic fauna, fisheries, and EFH. The calm water habitat created for loafing would also provide long-term benefits as nursery and foraging habitats for a variety of aquatic fauna.

Placement of shoreline protection features, which include the perimeter rock dike and possibly rock breakwaters adjacent to the island, and excavation of access channels would cause long-term, minor,

adverse impacts to aquatic fauna, fisheries, and EFH, including disruption of prey sources, noise disturbances, impacts to spawning and feeding habitats due to turbidity and siltation, and covering mud/soft bottom EFH with rock riprap. The shoreline protection features would increase the long-term resilience of the island by providing protection against erosion induced by waves. Impacts from transport of material from the Cat Island Pass borrow area would be negligible because dredged material would be transported via pipeline and placed on the island as a slurry.

Potential impacts to aquatic fauna, managed fisheries, and EFH would be considered and avoided or minimized to the extent practicable during design and construction. When impacts cannot be avoided, the LA TIG would apply appropriate EFH BMPs to minimize adverse impacts. BMPs would be implemented with the intent of minimizing the potential magnitude and duration of impacts to aquatic fauna, managed fisheries, and EFH. They would likely include standard erosion and sediment control measures to protect water quality and aquatic habitats from impacts resulting from construction and sediment runoff. Tidal connectivity to the marsh would be maintained and enhanced by the project design due to the incorporation of tidal exchange points. Specific BMPs for the protection of EFH would be identified and selected based on project elements and chosen construction methods during final E&D.

Dredging activities within the Cat Island Pass borrow area would cause short-term, minor, adverse impacts to aquatic fauna, managed fisheries, and EFH, including disruption of prey sources, noise disturbances, and impacts to spawning and feeding habitats due to turbidity and siltation.

4.3.2.2.4 Protected Species

Potential short-term, minor, adverse effects to protected species such as the West Indian manatee, dolphins, and sea turtles may include temporary, localized, noise impacts, entrapment, and collisions with watercraft and/or dredging equipment. They could also include temporary impacts to water quality from sediment turbidity due to construction activities, which could affect adjacent waters within the project area. Impacts to these species would be unlikely due to their ability to avoid disturbed areas. Adherence to the protection measures discussed below would minimize adverse impacts to any protected species that wander into the project area. They would likely move to another area for foraging or resting purposes, and there would be other available areas to which the animals may temporarily relocate. Based on similar projects, construction activities would not likely adversely affect these species.

The LA TIG is coordinating with USFWS and NOAA to complete technical assistance reviews under ESA Section 7 and all other applicable regulatory requirements. All regulatory requirements would be completed before project implementation. Any recommended avoidance or conservation measures would be evaluated and incorporated into the final design.

Several BMPs would be implemented during construction to minimize or avoid impacts to protected aquatic species. For any in-water work, the project would follow appropriate BMPs described in section 6A.1.8.3 of the Final PDARP/PEIS and would implement measures from NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006), *Measures for Reducing Entrapment Risk to Protected Species* (NMFS, 2012), *Vessel Strike Avoidance Measures and Reporting for Mariners* (NOAA, 2021a), and USACE *Standard Manatee Conditions for In-water Work* (USACE, 2011). These measures would minimize the potential for impacts to sea turtles, dolphins, and West Indian manatees.

Pollution prevention plans would be prepared in conjunction with the National Pollutant Discharge Elimination System permitting process prior to construction of the project. These plans would include all specifications and BMPs necessary for control of erosion and sedimentation during construction, which would minimize water quality impacts that could negatively affect protected species.

According to the USFWS IPaC, there is no critical habitat present within or adjacent to the project or borrow areas. The nearest critical habitat is for piping plover and is located south of the project area. Therefore, there would be no impacts to critical habitat due to the project.

4.3.2.3 Socioeconomic Resources

4.3.2.3.1 Cultural Resources

All projects must secure all necessary state and federal permits, and ensure the project is following all applicable laws and regulations concerning the protection of cultural and historic resources (DWH

Trustees, 2016). A complete review under Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108) would be initiated and completed before construction activities begin. If any culturally or historically significant resources are identified during project preparations or predevelopment surveys, such areas would be avoided during construction.

Although the project would cause sediment and ground disturbance, it is anticipated to have no effect on terrestrial or submerged cultural resources as no standing structures or known archaeological sites are in or near the project and borrow areas or the dredge pipeline corridor. Consultation with the State Historic Preservation Office and interested, federally recognized Indian tribes would ensure the area is compliant with Section 106 of the National Historic Preservation Act.

4.3.3 Environmental Consequences – Design Alternative 7

4.3.3.1 Physical Environment

4.3.3.1.1 Geology and Substrates

The impacts and benefits of design alternative 7 on geology and substrates would not differ significantly from those of the preferred alternative. The implementation of construction BMPs would help to minimize the impacts of construction. BMPs could include the implementation of erosion controls, installation of silt curtains to minimize turbidity (if needed), development of and adherence to a stormwater management plan, and ongoing construction monitoring.

4.3.3.1.2 Hydrology and Water Quality

The impacts and benefits of design alternative 7 on hydrology and water quality would not differ significantly from those of the preferred alternative. As for the preferred alternative, localized erosion and sediment transport are expected during dredged material placement, and the perimeter rock dike and internal earthen containment dikes would contain the majority of the fill material. Tidal exchange would be incorporated into project design. The equipment that would be utilized to construct design alternative 7 would be the same as that used for the preferred alternative. Establishment of and adherence to BMPs during construction should minimize water quality impacts as well as control of erosion and sedimentation due to construction-related activities.

4.3.3.2 Biological Environment

4.3.3.2.1 Habitats

The impacts and benefits of design alternative 7 on habitats would not differ significantly from those of the preferred alternative. As for the preferred alternative, design alternative 7 would involve restoration of ground nesting, shrub nesting, and marsh habitats through the placement of dredged material from the Cat Island Pass borrow area and possibly the construction of breakwaters that would provide calm water for loafing. The total habitat area for design alternative 7 is approximately 12 acres greater than for the preferred alternative.

4.3.3.2.2 Wildlife Species

The impacts and benefits of design alternative 7 on wildlife species would not differ significantly from those of the preferred alternative. Short-term, minor, temporary displacement of birds and other wildlife would be expected during construction. BMPs would be implemented to minimize impacts to wildlife through identification, avoidance, and bird abatement, as needed. The project would result in long-term, beneficial effects to wildlife species that rely on areas with higher elevation habitats for all or part of their life cycle.

4.3.3.2.3 Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms), EFH, and Managed Fish Species

The impacts and benefits of design alternative 7 on marine and estuarine fauna, EFH, and managed fish species would not differ significantly from those of the preferred alternative. Potential impacts would be considered and avoided or minimized to the extent practicable during design and construction. When impacts cannot be avoided, the LA TIG would apply appropriate BMPs to minimize adverse impacts.

4.3.3.2.4 Protected Species

The impacts and benefits of design alternative 7 on protected species would not differ significantly from those of the preferred alternative. All regulatory requirements would be completed before alternative implementation. Any recommended avoidance or conservation measures would be evaluated and incorporated into the final design. BMPs would be implemented during construction to minimize or avoid impacts to protected species. Pollution prevention plans would be prepared in conjunction with the National Pollutant Discharge Elimination System permitting process prior to construction of the project.

4.3.3.3 Socioeconomic Resources

4.3.3.3.1 Cultural Resources

The impacts of design alternative 7 on cultural resources would not differ significantly from those of the preferred alternative. The borrow area, equipment access corridor around the island, and access route from the Cat Island Pass borrow area to the project area would be the same for both alternatives.

4.3.4 Environmental Consequences – No Action

A no action alternative is included in the NEPA analysis as a basis for comparison of potential environmental consequences of the action alternatives. The no action alternative was analyzed at a programmatic level in the Final PDARP/PEIS and determined to cause much longer recovery rates for many resources, and in some cases, no recovery at all. In this case, no action would be to continue with the present course of action. Under the no action alternative, the Terrebonne HNC Island Restoration project would not be implemented. As such, the no action alternative would not address the purpose and need for restoration as described in Section 1.3 and would not meet the DWH Trustees' goals to restore and conserve barrier and coastal islands and headlands habitats (DWH Trustees, 2016).

The no action alternative would have no beneficial impacts to and no direct adverse effects on physical, biological, or socioeconomic resources. However, taking no action would indirectly allow some ongoing effects on resources to continue as described in the sections below.

4.3.4.1 Physical Environment

4.3.4.1.1 Geology and Substrates

The no action alternative would result in continued subsidence, and a failure to protect the area with habitat restoration would lead to long-term, minor, adverse impacts on the project area due to continued deterioration of natural sediment dynamics and erosion.

4.3.4.1.2 Hydrology and Water Quality

The no action alternative would result in continued reductions in island habitat area, which would lead to long-term, minor, adverse impacts on hydrology and water quality.

4.3.4.2 Biological Environment

4.3.4.2.1 Habitats

The no action alternative would result in long-term, minor, adverse impacts on habitat caused by continued erosion and would result in loss of existing marsh and nesting habitat.

4.3.4.2.2 Wildlife Species

The no action alternative would result in long-term, minor, adverse impacts on many wildlife species, including colonial nesting waterbirds and birds of conservation concern, that utilize current ground nesting, shrub nesting, and marsh habitat.

4.3.4.3 Socioeconomic Resources

4.3.4.3.1 Socioeconomics and Environmental Justice

The no action alternative would result in long-term, minor, adverse effects on socioeconomics and environmental justice caused by continued coastal erosion and land loss.

4.3.4.3.2 Public Health and Safety

The no action alternative would result in long-term, minor, adverse effects on public health and safety caused by continued coastal erosion and land loss.

4.3.5 Cumulative Impacts

Impacts are defined as "changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance from the proposed action or alternatives" (40 CFR §1508.1). As stated in the Council on Environmental Quality (CEQ) handbook, Considering Cumulative Effects (CEQ, 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on impacts that are truly meaningful. Cumulative impacts should be considered for all alternatives, including the no action alternative.

The Final PDARP/PEIS (Section 6.17.2) states that consideration of cumulative impacts of proposed alternatives in RP/EAs should build on the programmatic analyses and focus on site-specific issues (DWH Trustees, 2016). This is consistent with the 2014 CEQ guidance regarding effective use of programmatic NEPA analysis:

> An analysis of the cumulative impacts for each resource would be provided in each level of review, either by relying upon the analysis in the programmatic NEPA review or adding to that analysis in the tiered NEPA review, either approach facilitated by incorporating by reference the cumulative impact analysis provided in the programmatic NEPA review (CEQ, 2014).

The LA TIG determined that the conditions and environmental impacts described in the Final PDARP/PEIS are valid and relied upon the cumulative impacts analysis therein for the alternatives analyzed in this RP/EA, where applicable. Considering context and intensity, the LA TIG considers resources with negligible to minor direct and indirect impacts described in this RP/EA as sufficiently analyzed cumulatively in the Final PDARP/PEIS (DWH Trustees, 2016).

4.3.5.1 Methods for Assessing Cumulative Impacts

Section 6.6.2 of the Final PDARP/PEIS outlines the following steps involved in a cumulative impact analysis: (1) identify the resources affected, (2) establish the boundaries of analysis, (3) identify the cumulative impacts scenario, and (4) conduct a cumulative impacts analysis. Additional discussion of these steps in the Final PDARP/PEIS are incorporated herein by reference. As summarized above, resources with negligible to minor direct and indirect impacts as described in this RP/EA were not carried forward in the cumulative impacts analysis. For this RP/EA, the spatial boundary of the cumulative impacts analysis is at a local scale. Accordingly, the LA TIG applied a two-mile buffer to the spatial extent of the project area to capture the past, present, and reasonably foreseeable future actions that should be considered in combination with each alternative. The LA TIG was unable to identify any relevant past, present, and reasonably foreseeable future actions not analyzed in previous documents.

4.3.5.2 Resources Affected

Because the LA TIG was unable to identify any relevant past, present, and reasonably foreseeable future actions that could be assessed for cumulative impacts, no discussion of resources analyzed for potential environmental consequences, beyond that presented in Sections 4.2 or 4.3, is required.

4.3.5.3 Cumulative Action Scenario

4.3.5.3.1 Terrebonne HNC Island Restoration Project

There are no existing or pending projects whose footprints or areas of influence intersect a 2-mile buffer around the project area, therefore there are no past, present, and reasonably foreseeable projects and actions in the project area. As a result, the cumulative project effects would be equivalent to the project effects noted in Section 4.3.2. The only resources for which impacts of the Terrebonne HNC Island

Restoration project were found to be more severe than “minor” are geology and substrates, habitats, wildlife, and marine and estuarine fauna. The anticipated short-term, moderate, adverse impacts to these resources from construction could be minimized with the development and implementation of BMPs. When implementation of other bird nesting and habitat restoration projects in Louisiana are considered more broadly, there would be beneficial impacts on Louisiana bird species and suitable bird nesting habitat, which is a limited resource in Louisiana.

4.3.5.3.2 No Action Alternative

Under the no action alternative described in Section 2.3.2, the Terrebonne HNC Island Restoration project would not be implemented. Although other environmental stewardship actions may occur in the Terrebonne Basin, the no action alternative may reduce the benefits to resources including geology and substrates, hydrology and water quality, habitats, wildlife, protected species, socioeconomics and environmental justice, and public health and safety. Under the no action alternative, the existing habitats would continue to degrade due to erosion, local subsidence, and sea level rise, which could result in the decrease or elimination of habitat and the species which utilize that habitat.

5 Compliance with Other Laws and Regulations

In addition to the requirements of OPA and NEPA, other laws may apply to the preferred alternative in this RP/EA. The LA TIG ensures compliance with applicable laws or EOs. Details on each of these laws or EOs can be found in Chapter 6 of the Final PDARP/PEIS (DWH Trustees, 2016). Legal authorities applicable to restoration alternative development were fully described in the context of the DWH restoration planning in the Final PDARP/PEIS, Section 6.9 Compliance with Other Applicable Authorities and Appendix 6.D Other Laws and Executive Orders (DWH Trustees, 2016). That material is incorporated by reference here.

5.1 Federal Laws

Additional federal laws, regulations, and EOs that may be applicable include but are not limited to:

- Endangered Species Act (16 U.S.C. § 1531 *et seq*.)
- Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (16 U.S.C. § 1801 *et seq*.)
- Marine Mammal Protection Act (16 U.S.C. § 1361 *et seq*.)
- Coastal Zone Management Act (16 U.S.C. § 1451 *et seq*.)
- National Historic Preservation Act (16 U.S.C. § 470 *et seq*.)
- Coastal Barrier Resources Act (16 U.S.C. § 3501 *et seq*.)
- Migratory Bird Treaty Act (16 U.S.C. § 703 *et seq*.)
- Bald and Golden Eagle Protection Act (16 U.S.C. § 668 *et seq*.)
- Clean Air Act (42 U.S.C. § 7401 *et seq*.)
- Federal Water Pollution Control Act (Clean Water Act, 33 U.S.C. § 1251 *et seq*.) and/or Rivers and Harbors Act (33 U.S.C. § 401 *et seq*.)
- Marine Protection, Research, and Sanctuaries Act (16 U.S.C. § 1431 *et seq*. and 33 U.S.C. § 1401 *et seq*.)
- Estuary Protection Act (16 U.S.C. §§ 1221–1226)
- Archaeological Resource Protection Act (16 U.S.C. §§ 470aa–470mm)
- National Marine Sanctuaries Act (16 U.S.C. § 1431 *et seq*.)
- Farmland Protection Policy Act (7 U.S.C. §§ 4201–4209)
- EO 11988: Floodplain Management (May 24, 1977), as amended
- EO 11990: Protection of Wetlands (May 24, 1977), as amended
- EO 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Feb. 11, 1994), as amended
- EO 12962: Recreational Fisheries (June 7, 1995), as amended
- EO 13007: Indian Sacred Sites
- EO 13045: Protection of Children from Environmental Health Risks and Safety Risks (Apr. 23, 1997), as amended
- EO 13112: Safeguarding the Nation from the Impacts of Invasive Species (Feb. 3, 1999), as amended
- EO 13175: Consultation and Coordination with Indian Tribal Governments (Nov. 6, 2000)

- EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds (Jan. 10, 2001)
- EO 13693: Planning for Federal Sustainability in the Next Decade
- EO 13985: Advancing Racial Equity and Support for Underserved Communities Through the Federal Government (Jan. 20, 2021)
- EO 13990: Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis (Jan. 20, 2021)
- EO 14008: Tackling the Climate Crisis at Home and Abroad (Jan. 27, 2021)
- EO 14072: Strengthening the Nation's Forests, Communities, and Local Economies (Apr. 22, 2022)

5.2 State and Local Laws

The LA TIG would confirm compliance with all applicable state and local laws and other applicable federal laws and regulations relevant to the State of Louisiana. Additional laws and regulations are listed below:

- Archeological Finds on State Lands (La. Rev. Stat. 41:1605)
- Coastal Wetlands Conservation and Restoration Authority (La. Rev. Stat. 49:213.1)
- Coastal Wetlands Conservation and Restoration Plan (La. Rev. Stat. 49:213.6)
- Louisiana State and Local Coastal Resources Management Act (La. Rev. Stat. 49:214.21 – 214.42)
- Louisiana Oil Spill Prevention and Response Act (La. Rev. Stat. 30:2451 *et seq*.)
- Management of State Lands (La. Rev. Stat. 41:1701.1 *et seq*.)
- Louisiana Coastal Resources Program (Louisiana Administrative Code [La. Admin. Code] 43:700 et seq.)
- Louisiana Surface Water Quality Standards (La. Admin. Code 33.IX, Chapter 11)
- Management of Archaeological and Historic Sites (La. Rev. Stat. 41:1605)
- Oyster Lease Relocation Program (La. Admin. Code 43:I, 850-859, Subchapter B)
- Louisiana Scenic Rivers Program (La. Rev. Stat. 56:1856)

5.3 Summary and Next Steps

The LA TIG would ensure compliance reviews and/or approvals under all applicable state and local laws and other applicable federal laws and regulations that are relevant to any selected design alternative are complete before implementation. Implementing Trustees are required to implement alternative-specific mitigation measures, including BMPs, that are identified in this RP/EA and in the completed consultations/permits and biological evaluation forms. Implementing Trustees would provide oversight 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. A summary of environmental compliance status will be provided in the Final RP/EA #7.1.

6 List of Preparers and Agencies Consulted

Table 6-1. List of Preparers and Agencies Consulted.

Agency/Firm	Name	Position
CPRA	Maury Chatellier	DWH Oil Spill Program Administrator
CPRA	Erin Vidrine	Coastal Resources Scientist
CPRA	Renee Bennett	Project Manager
CPRA	Casey Wright	Coastal Resources Scientist
LDWF	Annie Howard	Coastal Resources Scientist Manager
DOI	Sarah Clardy	DOI LA TIG Representative
DOI	Robin Renn	DWH NEPA Coordinator
DOI	Amy Mathis	Restoration Planner
DOI	David Hewitt	Fish and Wildlife Biologist
DOI	Michael Barron	Wildlife Biologist – Compliance Coordinator
DOI	John Rudolph	Solicitor
DOI	Clare Cragan	Solicitor
NOAA	Ramona Schreiber	DWH NEPA Coordinator
USEPA	Douglas Jacobson	USEPA Team Leader
Royal	Kirk Rhinehart	Principal
Royal	Mandy Green	Senior Scientist
Royal	Alaina Grace	Project Manager
Royal	Jennifer Peers	Senior Scientist
Royal	Kendra Babcock	Project Scientist

7 List of Repositories

Table 7-1. List of Repositories.

Library	Address	City	Zip Code
St. Tammany Parish Library	310 W. 21st Avenue	Covington	70433
New Orleans Public Library, Louisiana Division	219 Loyola Avenue	New Orleans	70112
St. Bernard Parish Library	1125 E. St. Bernard Highway	Chalmette	70043
Plaquemines Parish Library	8442 Highway 23	Belle Chasse	70037
Jefferson Parish Library, East Bank Regional Library	4747 W. Napoleon Avenue	Metairie	70001
Jefferson Parish Library, West Bank Regional Library	2751 Manhattan Boulevard	Harvey	70058
Terrebonne Parish Library	151 Library Drive	Houma	70360
Martha Sowell Utley Memorial Library	314 St. Mary Street	Thibodaux	70301
South Lafourche Public Library	16241 E. Main Street	Cut Off	70345
East Baton Rouge Parish Library	7711 Goodwood Boulevard	Baton Rouge	70806
Alex P. Allain Library	206 Iberia Street	Franklin	70538
St. Martin Parish Library	201 Porter Street	St. Martinville	70582
Iberia Parish Library	445 E. Main Street	New Iberia	70560
Vermilion Parish Library	405 E. St. Victor Street	Abbeville	70510
Mark Shirley, LSU AgCenter	1105 West Port Street	Abbeville	70510
Calcasieu Parish Public Library Central Branch	301 W. Claude Street	Lake Charles	70605

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Appendix A. Monitoring and Adaptive Management Plan

Monitoring and Adaptive Management Plan for Deepwater Horizon NRDA Project: Terrebonne HNC Island Restoration Project

Original Date: June 9, 2022

Modified Date: August 3, 2022

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1 Introduction

The Deepwater Horizon (DWH) Louisiana Trustee Implementation Group (LA TIG) developed this monitoring and adaptive management plan (MAM plan) for the Terrebonne HNC Island Restoration Project (TE-0165; the Project), which represents one of seven projects selected from within the broader Louisiana Trustee Implementation Group Final Restoration Plan and Environmental Assessment #7: Wetlands, Coastal, and Nearshore Habitats and Birds (RP) on November 13, 2020. The purpose of this MAM plan is to identify monitoring activities that will be conducted to evaluate and document restoration effectiveness, including performance criteria for determining restoration success or need for interim corrective action (15 Code of Federal Regulations [CFR] 990.55(b)(1)(vii)).

Where applicable, the MAM plan identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. It also establishes a decision-making process for making adjustments where needed.

There are three primary purposes for MAM plans:

1. Identify and document how restoration managers will measure and track progress toward achieving restoration goals and objectives
2. Before a project begins, increase the likelihood of successful implementation through identification of potential corrective actions that could be undertaken if the project does not proceed as expected
3. In a systematic way, ensure the capture of lessons learned or new information acquired that can be incorporated into future project selection, design, and implementation

The MAM plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to the MAM plan will be made available through the Restoration Portal (at the following URL: https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the DWH Natural Resource Damage Assessment (NRDA) Trustees' website (at the following URL: https://www.gulfspillrestoration.noaa.gov/).

1.1 Project Overview

The Terrebonne HNC Island Restoration Project (TE-0165) is located within the Terrebonne Hydrologic Basin in Terrebonne Parish, Louisiana (Figure 1). This island is one of the state's 10 remaining historic brown pelican colonies and was impacted by the spill (e.g., impacts to Colonial Waterbirds (CWBs) [all age classes] and their nesting and brooding habitats) (Remsen, Jr. et al. 2015; Baker et al. 2015). In response, the LA TIG proposed the selection of the Project as one means to restore for these impacted bird resources.

This project is designed to restore and enlarge the island from its current size of 27.6 acres to approximately 42 acres. This would be accomplished by importing dredged sediment from a nearby suitable sand source and disposing of it adjacent and onto the existing island. Prior to placing sand, the existing rock ring would be restored for two purposes. First, the rock ring would contain the deposited sediment and second, it would provide erosion protection from wind driven wave energy. Island elevation would be increased to prevent routine tidal inundation with the intention of increasing nesting success. Targeted breakwaters would be installed as an additional measure of protection and would provide a calm water loafing area for young birds. Limestone aggregate would be deposited adjacent to the edge of the island to create a low maintenance ground nesting feature for terns and black skimmers (*Rynchops niger*). Following

construction, the island may be planted with suitable vegetative species (e.g., Iva, Baccharis, Lycium, Avicennia) to provide optimal nesting substrate. (Figure 2).

Figure 1. Terrebonne HNC Island. Terrebonne Parish, Louisiana. (Source: Google Map 2022)

Figure 2. Proposed Restoration Design for Terrebonne HNC Island.

The Project is being implemented as restoration for the DWH oil spill NRDA, consistent with the Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement and the Deepwater Horizon Oil Spill Natural Resource Damage Assessment Strategic Framework for Bird Restoration Activities (the Framework).

- Programmatic Goal: Replenish and protect living coastal and marine resources
- Restoration Type: Birds
- Restoration Approaches: Restore and conserve bird nesting and foraging habitat; create, restore, and enhance barrier and coastal islands and headlands
- Restoration Techniques: Restore or construct barrier and coastal islands and headlands via placement of dredged sediments; enhance habitat through vegetation management; construct groins, breakwaters, or use sediment bypass methods
- Trustee Implementation Group: LA TIG

The implementing agency is State of Louisiana in partnership with the U.S. Fish and Wildlife Service (USFWS).

1.2 Restoration Type Goals and Project Restoration Objectives

The Project's primary goal is to create and/or enhance Terrebonne HNC Island's current suitable CWB nesting and brood-rearing habitat (currently ~ 4 acres) to ~41 acres[1] with an anticipated habitat breakdown as follows: shrub-nesting habitat including brown pelican (*Pelecanus occidentalis*) and wading birds (~27 acres), marsh habitat which generates multi-species benefits (~ 10.5 acres) and ground-nesting habitat including terns (primarily *Sterna spp.* and *Thalasseus spp*.) and black skimmers (~3.9 acres). In so doing, Trustees envision the Project will generate additional CWB nesting opportunities that will compensate, in part, for bird losses associated with the spill. Specific project restoration type goals are identified below:

Restoration Type Goals

- Restore lost birds by facilitating additional production and/or reduced mortality of injured bird species
- Restore and protect habitats on which injured birds rely
- Restore injured birds by species where actions would provide the greatest benefits within geographic ranges that include the Gulf of Mexico

In achieving these identified restoration type goals, Trustees will accomplish the Project's principal restoration objectives.

Restoration Objectives

Objective #1: Restore/Create Terrebonne HNC Island habitat for utilization of brown pelicans, gulls, wading birds, terns, and black skimmer nesting activity

- Parameter #1: Area of potential nesting habitat for brown pelicans and/or wading birds
- Parameter #2: Area of potential nesting habitat for terns and skimmers

Objective #2: Support nesting activity for brown pelicans, gulls, wading birds, terns, and black skimmer that contributes to making the environment and the public whole for spill-related injuries

- Parameter #3: CWB nesting activity

While the primary project goal is well defined, it is acknowledged that the restoration plan is conceptual. Throughout the design process, project team members, including the Coastal Protection and Restoration Authority (CPRA), the Louisiana Department of Wildlife and Fisheries (LDWF), and the USFWS will have the opportunity to refine design parameters as additional information becomes available.

Performance criteria will be identified/implemented to determine restoration success or the need for corrective action in accordance with 15 CFR 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives in Section 5.0.

1.3 Conceptual Setting

The purpose of the conceptual setting within the MAM plan is to identify, document, and communicate interactions and linkages among system components at the project site and to

[1] Total project acreage (43 acres) consists of ~41 acres of CWB nesting and brooding habitats and ~2 acres of rock containment dike.

understand how these system works may be affected by the associated restoration (see MAM Manual) (Table 1).

Table 1. Conceptual Model for Terrebonne HNC Island Restoration Project.

Restoration Actions	As-Built	Interim	Restoration Goal
Place suitable imported sediments within an enhanced rock ring that surrounds the island	Create or enhance ~41 acres of CWB nesting and brooding habitat	Suitable imported sediments compact and dewater to desired elevation for targeted CWB nesting and brooding habitat. Planted native vegetation survives and expands to achieve desired species composition and percent cover, which supports CWB nesting and brooding opportunities. Ground nesting feature created adjacent to the island edge which supports tern nesting and brooding opportunities.	Newly constructed habitat attracts desired CWB species (brown pelican, wading birds, gull, tern, and skimmer) for nesting and brooding opportunities. Newly constructed habitat has a 20-year lifespan. Balance cost, quality, and urgency effectively. Provide ecological services that contribute to making the environment and the public whole for spill-related injuries to these resources.

1.3.1 Potential Sources of Uncertainty

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 utilized a variety of sources, including but not limited to Strategic Framework for Bird Restoration Activities, PDARP/PEIS Restoration Type MAM sections, Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0, DWH injury assessment technical reports, and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions in the event the Project is not meeting its performance criteria (Table 2). Potential options to address key uncertainties may be found in the Framework and other sources.

Table 2. Key Uncertainties.

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision-Making
1	Contractor completing the Project on time	Contractor's inability to complete the Project within the designated time frame would delay resource restoration and require allocation of additional resources for project completion.
2	Availability of suitable nesting habitat within the Northern Gulf of Mexico	There are several restoration activities that are taking place across coastal Louisiana and the northern Gulf Coast. Many of these projects could provide habitat for nesting birds, especially black skimmers and terns. This additional amount and diversity of potentially high-quality habitat could lower the number of nesting birds on Terrebonne HNC Island, reducing the apparent short-term effectiveness of the Project. Potential options to address this uncertainty include, but are not limited to, social attraction techniques.

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision-Making
3	Suitability of restored island to mammalian nest predators	The presence of mammalian predators within CWB colonies has been shown to be highly detrimental to nesting success and hatchling/fledgling survival. Potential options to address this uncertainty include, but are not limited to, predator removal or colony fencing to reduce/eliminate access by mammalian predators.
4	Success of vegetation plantings	Lack of planting success has the potential to limit creation of preferred nesting habitat (i.e., vertical structure) for many CWB species. This would result in lower quality, or lack of suitable, habitat for brown pelican and a number of wading bird species (e.g., great egrets, reddish egrets, and tricolored herons).
5	Colonization of the island by invasive vegetative species such as Roseau cane (*Phragmites australis*) and/or Chinese tallow (*Triadica sebifera*)	Colonization by non-native plant species could result in habitat that is less preferred by CWB for nesting and brooding and would therefore not support proposed project objective (i.e., increase CWB nesting opportunities). Potential options to address this uncertainty include, but are not limited to, utilization of chemical, mechanical, or other removal techniques.
6	Climate impacts and extreme weather events such as hurricanes, tropical storms, sea level rise and droughts	Effects of these ephemeral events have been shown to cause mortality in all CWB in all age classes (adults, juveniles, young of the year) as well as loss of critical nesting and brooding habitats.
7	Anthropogenic disturbance	Anthropogenic disturbance has been shown to significantly impact CWB nesting success and hatchling/fledgling survival via limiting parental attendance. Potential options to address this uncertainty include, but are not limited to, signage indicating restricted distance to colonies at certain times of the year, law enforcement, or other methods.
8	Avian disease	Occurrence of avian disease has the potential to harm all CWB age classes (adults, juveniles, young of the year) and could result in colony failure. Potential options to address this uncertainty include, but are not limited to, creation or enhancement of additional CWB islands to reduce bird densities and thereby prevalence of disease presence and frequency.

2 Project Monitoring

The MAM plan was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed. For each of the identified monitoring parameters, information is provided as to their intended purpose (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. Further, these parameters will be monitored to demonstrate how the restoration project is trending toward the performance criteria and to inform the need for corrective actions (see Project-Level Decisions section).

Though additional measures may be implemented to more fully characterize the Project's effectiveness, the LA TIG proposes the continued implementation of proven and established monitoring methodologies:

Objective #1: Restore/Create Terrebonne HNC Island habitat for the utilization of brown pelicans, terns, skimmers, and wading bird nesting activity.

- Parameter #1: Area of potential nesting habitat for brown pelicans and/or wading birds
  a) Purpose: To determine the amount (acreage) of habitat that is suitable for nesting of each of the targeted avian species/groups.
  b) Method: Two data collection methods will be utilized to determine habitat acreages. Data collection methodology will consist of:
     - High resolution, near vertical aerial imagery
     - Ground surveys utilizing the Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) to validate the habitat mapping of the imagery
  c) Timing, Frequency, and Duration: Post-construction years 1, 3, 5, and 10, with confirmatory assessments at 20 years that may employ alternative methods to those described here, if advancements in monitoring allow, to meet the DWH Trustees MAM Manual recommendations (v2 attachment E).
     - High resolution, near vertical aerial imagery will be collected in late May/early June to coincide with the CWB surveys.
     - Ground surveys will be conducted prior to nesting season to collect data that will show the availability of plants and habitat for nesting. Ground surveys will not be conducted during nesting season so there are no disturbances to the colonies.
  d) Sample Size:
     - For the high resolution, near vertical aerial imagery, the sample size will be the entire island.
     - For the ground surveys, the sample size will be 14 or 27 plots (1 station for each acre or 1 station for every 2 acres) for the shrub-nesting habitat, and 5 or 10 plots for the marsh-nesting habitat, or plots will be distributed based on the percentage of each habitat created. For example, if there is 60% shrub-nesting habitat then 60% of the stations will be established in the shrub-nesting habitat. Exact number of stations will be determined post-construction.
  e) Sites: Vegetation stations will be established interior to the perimeter rock containment dike at randomly selected locations in the areas designed as shrub-nesting and marsh habitats.
- Parameter #2: Area of potential nesting habitat for terns and skimmers
  a) Purpose: This parameter will be used to inform vegetation removal and limestone supplementation and to inform post-execution adaptive management.
  b) Method: Determine the amount (acreage) of habitat that is suitable for nesting and brooding for each of the targeted avian species/guilds. This will be the result of an analysis (emergent vegetation presence or absence, emergent vegetation at or below 10 percent of total area) using several data types, including:
     - High resolution, near vertical aerial imagery

- Ground surveys utilizing the Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) to the habitat mapping of the imagery

c) Timing, Frequency, and Duration: Post-construction years 1, 3, 5, and 10, with confirmatory assessments at 20 years

d) Sample Size:

- For the high resolution, near vertical aerial imagery, the sample size will be the entire island.
- For the ground surveys, the sample size will be 2 or 4 plots (1 stations for each acre or 1 station for every 2 acres) or they will be distributed based on the percentage of each habitat created. For example, if there is 60% shrub habitat then 60% of the stations will be established in the shrub habitat. Exact number of stations will be determined post-construction.

e) Sites: Vegetation stations will be established interior to the perimeter rock containment dike at randomly selected locations in the areas designed for ground-nesting birds per the construction design drawings.

Core parameters to be measured are consistent with the DWH Trustees MAM Manual (v2 attachment E) to include density of birds, species composition of birds, and abundance of birds.

Objective #2: Support nesting activity for brown pelicans, terns, skimmers, and wading birds that contributes to making the environment and the public whole for spill-related injuries

- Parameter #3: CWB nesting activity and density (nest count and nesting pairs) density of birds, species composition of birds, and abundance of birds

a) Purpose: This parameter will be used to evaluate the effectiveness of the Project in increasing nesting of the targeted species (Framework, Appendix A, Colonial Waterbirds) and to inform adaptive management.

b) Method: High resolution, low altitude oblique aerial digital photography (Ford 2010; Appendix A) and high altitude overview photographic survey (Colibri 2022).

c) Timing, Frequency, and Duration: Surveys will be conducted during post-construction years 1, 3, 5, and 10, with confirmatory assessments at 20 years. Due to the bimodal nature of the CWB nesting season, two representative surveys will be implemented for each of the years indicated: the initial survey (mid-May) followed by the final survey (mid-June).

3 Adaptive Management

Monitoring information collected at the project level can also inform adaptive management (a form of structured decision-making applied to the management of natural resources in the face of uncertainty of that individual project) (Pastorok et al. 1997; Williams 2011). Within the LA TIG, an adaptive management framework has been developed that identifies and characterizes the four main phases and is illustrated within a representative management cycle (Figure 3).

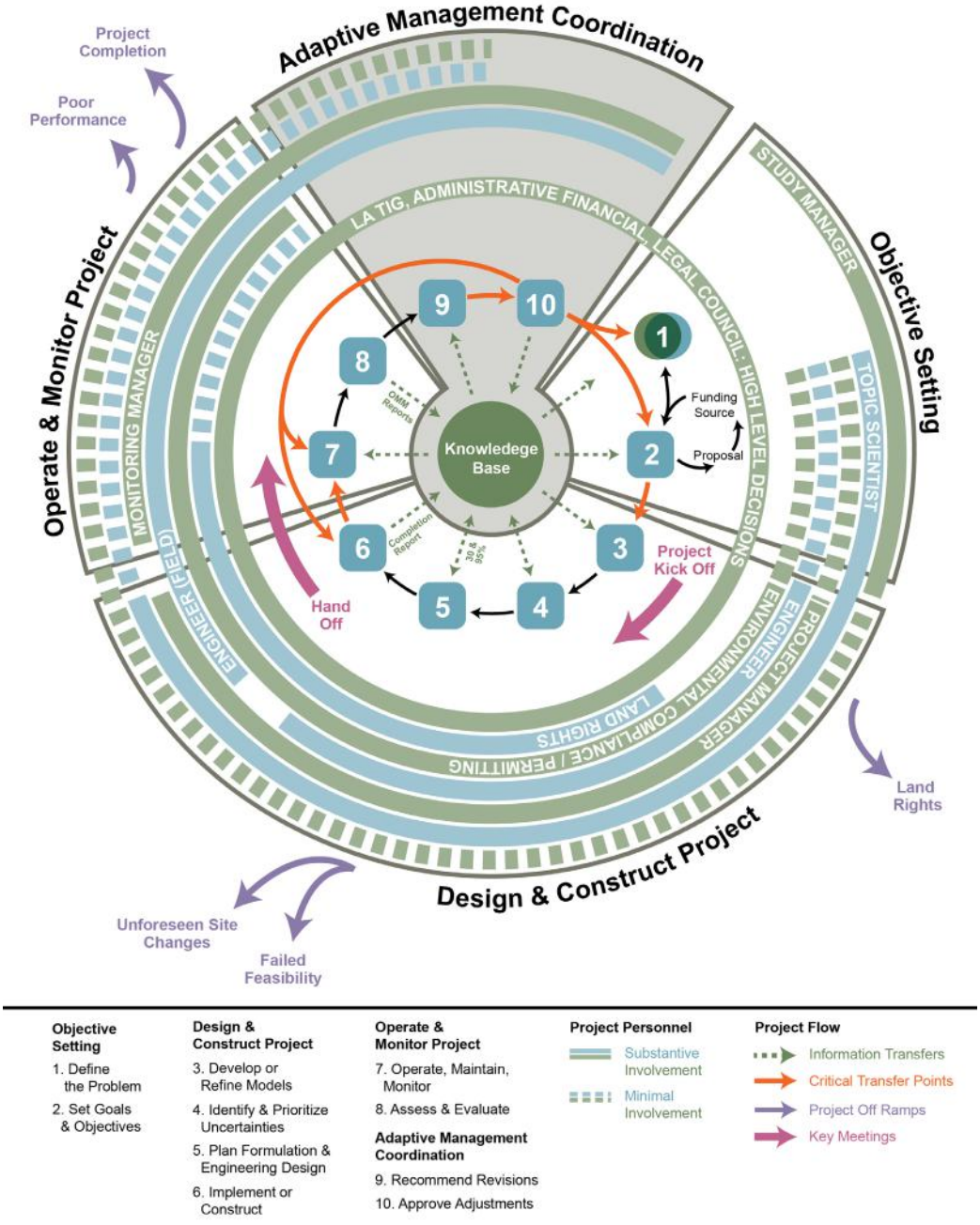

Figure 3. LA TIG Adaptive Management Cycle (Source: The Water Institute of the Gulf, 2020).

- Objective-Setting Phase: Problem is identified or defined, and project goals and objectives are established based on multiple sources, including lessons learned, data and associated synthesis, and applied research from previous projects and from the knowledge base as a whole. For the Terrebonne HNC Island Restoration Project (TE-0165), the goal setting phase is already complete – the problem of marsh loss has been defined through the PDARP/PEIS as well as through Louisiana's Coastal Master Plan process, and the goals and objectives of restoration are as described in the restoration plan that accompanies this MAM Plan.

- Design and Construct Phase: Project advances through select steps, including model development or refinement, identification and prioritization of uncertainties, plan formulation, engineering, design, and project construction. For this project, the elements of a preliminary design have already been described within the restoration plan, incorporating available data on water depths, intertidal range for nearby marsh, and local subsidence rates. As the project advances to more advanced phases, the design may be modified as needed to incorporate any new information that could affect the preliminary design.
- Operate and Monitor Phase: Project's operations, maintenance, and monitoring plans are developed, and project assessment and evaluation criteria are identified. Note that for this and other marsh creation projects, the opportunities for adaptive management post-construction may in some cases be limited. For example, if the marsh platform does not achieve the proper elevation post-settlement, re-mobilizing a dredge to modify the marsh platform elevation is generally cost-prohibitive. However, supplemental vegetative plantings can be used to improve vegetative cover if the marsh platform is already at the proper elevation.
- Adaptive Management Coordination Phase: Encompasses steps for recommending and approving project revisions so that revisions can achieve one or both of the following:
    - Result in alterations and redesign of project elements or changes to project operation
    - Provide input to either the understanding of the overall problem statements or the refinement of attainable or realistic goals and objectives for future projects

Where gaps in scientific understanding exist, project information collected (see Section 2, Project Monitoring) and evaluated (see Section 4, Evaluation) may be utilized by the LA TIG to reduce key uncertainties and/or other analyses that inform the selection, design, and optimization of future restoration projects (Framework).

4 Evaluation

Evaluation of monitoring data is needed to assess the project implementation and performance in meeting restoration objectives, resolving uncertainties to increase understanding, and determining whether corrective actions are needed.

As part of the larger decision-making context, the evaluation of monitoring data from individual projects could also be compiled and assessed at the restoration type and LA TIG level, and the results would be used to update the knowledge base to inform decisions such as future LA TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties.

The results of these analyses would be used to answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Did the restoration project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?

Proposed analysis methods for monitoring parameters are grouped under stated objective headings and will be updated as necessary:

Objective #1: Restore/Create Terrebonne HNC Island habitat for utilization of brown pelicans, terns, skimmers, and wading bird nesting activity

Analysis: Vegetative Structure and Composition: General descriptive statistical analyses may include, but are not limited to, averages/means of the overall total cover and total cover by herbaceous species and/or shrubs; percent cover of species; and/or average height of dominant/key species. After each data collection effort, all collected and analyzed data will be evaluated to determine existing habitat type and avian utilization. After multiple data collection efforts, comparisons between each time period will be assessed to determine the evolution of the habitat and how avian species are reacting to the changes. Data will also provide ground-truthing information for the habitat mapping effort.

Analysis: Habitat Mapping: Near vertical, high resolution aerial imagery will be used to map habitats. Habitat mapping will be consistent with the CPRA Louisiana's Barrier Island Comprehensive Monitoring (BICM) program's utilization of the detailed fifteen-class classification scheme (Enwright et al., 2020). The BICM detailed classification scheme methodology is consistent with the recommendation in the Draft Ecosystem Restoration and Monitoring to Create and Improve Bird Nesting Habitat that is currently in the final stages of development.

Objective #2: Support nesting activity for brown pelicans, terns, skimmers, and wading birds that contributes to making the environment and the public whole for spill-related injuries

Analysis: CWB Nesting Activity: High resolution, low altitude (750-1,000 ft Above (mean) Sea Level (ASL)) oblique aerial photographs (Appendix A) will be collected using an accepted method (Ford 2010). Photographs from May and June surveys will be evaluated for their representation of peak breeding population size for each species at each colony. For most species, photographs from May surveys will represent peak breeding numbers and will be selected for analysis. For some species, especially black skimmer, photos from June surveys will better represent peak numbers and will be used for analysis. Occasionally, especially for brown pelican, royal tern (*Thalasseus maximus*), and sandwich tern (*Thalasseus sandvicensis*), well-developed colonies will be counted using May photographs, but additional large nesting groups that form after the May survey will be counted from June photographs and summed with May counts for a total number of nests.

All high resolution, low altitude oblique aerial photographs of each individual colony will be inspected for clarity, location within the colony, and extent of colony coverage. Those best suited for nest dotting analyses based on those criteria and collectively comprising all areas will be selected. Where overlapping images are used to analyze portions of a colony, one or more lines will be drawn on the selected image to delineate the area to be counted using that image. Areas outside any such lines will then be counted using different images. This process will continue until the colony is counted completely with available photographs.

A high altitude (1,500 to 3,000 ft ASL) overview photographic survey will also be implemented using an accepted method (Colibri 2022). Use of a gyroscopically stabilized fixed camera mount will result in an image that is taken at a near-perpendicular aspect relative to the ground. Further, GPS location of each photograph will be recorded to metadata using a commercial GPS receiver affixed to the camera. All high altitude overview photographs will be inspected for clarity, location within the colony, and extent of colony coverage. Those best suited will be post processed using established georeferencing methods and mosaicked into a high resolution

base mapping resource (Chapman and Wieczorek 2020). Representative low altitude aerial photographs will then be georeferenced using the high resolution, high altitude mosaic as an orientating layer thereby resulting in a singular imagery resource (a mosaic of high resolution photos for a given colony location) that is capable of supporting future analyses (i.e., nest dotting, characterizing bird / habit relationships, habitat evaluations, etc.).

Nest dotting analyses encompass the manual marking (dotting) of nests and birds within the mosaic of high resolution, low altitude oblique aerial photographs; an ArcGIS-based platform. Upon completion, all dotting results are automatically displayed within a designated point count window. By design, the template standardizes both the feature domain and symbology of species and bird/nest delineations. Although the primary objective will be to determine number of nests, individual birds and chicks of each species will be counted in each photograph. All data will be manually entered into a Microsoft Access database.

For brown pelican, nests will be categorized by their stage of development. These categories will include the following:

- Well-built nest (with attending adult and with or without chicks)
- Poorly built nest (pre-egg laying)
- Nest with chicks but without attending adults
- Abandoned nest (with eggs but unattended)
- Empty nest (early-season unattended without eggs or chicks)
- Brood (dependent chicks away from an obvious nest and not attended by an adult)

Together, these categories will provide numbers of pelican nests and breeding pairs at each colony based usually on a single aerial photographic survey even though egg-laying dates may span a period of months. For other species, all nests and territories will be marked more generally as “sites.” The detailed nest categories that will be used for brown pelicans are inappropriate for other species because of their small size (terns and gulls), scrape-nesting habits (terns and skimmers), or partial concealment by vegetation (waders and gulls).

Compiling Data

After analyzing an image with the software, a screen capture of the analyzed image will be saved as a jpeg file. The screen capture will show all data, including image number, all symbols that marked nests and birds, total counts for each category, colony name, area number, the initials of the photo analyst, the date the image was analyzed, and any other annotations the photo analyst added. All screen captures will be saved with standardized file names and archived in colony-specific folders. All data from each screen capture will be manually entered into a Microsoft Access database.

Assessing Colony Conditions

Each analyzed image will be evaluated to characterize conditions at each colony. Core parameters to be measured are consistent with the DWH Trustees MAM Manual (v2 attachment E) to include density of birds, species composition of birds, and abundance of birds and will include the following:

- The stage of the breeding cycle (e.g., early-, mid-, or late-incubation; early chick-rearing) for each species.
- Habitat occupancy (numerical and geographic extent to which each species occupied the habitat).

- Reproductive performance (e.g., pattern of abandonment, if any, chick production).
- Information specific to a particular image will be entered into a notes field in the main data table in the Access database. Information concerning the colony as a whole will be entered in a separate data table in the same database.

Project-Level Decisions: Performance Criteria and Potential Corrective Actions

In this section, the LA TIG describes how updated knowledge gained from the evaluation of monitoring data will be used at the project-level to determine whether the Project is considered successful or whether corrective actions are needed. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Learning through monitoring allows for corrective actions to be made to achieve desired outcomes. Table 3 identifies performance criteria, monitoring parameters, and potential corrective actions that could be taken if the performance criteria are not met (as defined in NRDA regulations (15 CFR 990.55(b)(1)(vii)). This table should not be considered all encompassing; rather, it represents a listing 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 and included in an operations and maintenance (O&M) plan. The decision of whether or not a corrective action should be implemented for the Project should consider the overall outcomes of the restoration project (i.e., looking at the combined evaluation of multiple performance criteria) in order to understand why project performance deviates from the predicted or anticipated outcome. Corrective action may not be taken in all cases based on such considerations. The knowledge gained from this process could also inform future restoration decisions such as the selection, design, and implementation of similar projects.

Table 3. List of Project Monitoring Parameters, Performance Criteria, and Potential Corrective Actions.

Table Note: *The table provides the triggers for helping determine whether adjustments to the Project are needed based on the performance criteria; potential corrective actions for unknown or unanticipated conditions, should they arise, would need to be determined.

Monitoring Parameter	Final Performance Criteria Used to Determine Project Success	Interim Performance Criteria	Potential Corrective Actions or Mid-Course Corrections*
Area of potential nesting habitat for shrub-nesting birds (brown pelicans and/or wading birds)	At year 10 post-construction, at least 15 ± 2 acres of select habitat will consist of at least 50 percent ± 5 percent vegetative cover, with confirmatory assessments at 20 years.	At year 3 post-construction, information gathered to inform future planting effort and invasive vegetation removal.	Perform supplemental planting(s) of preferred native vegetation; eradicate unwanted vegetation. (Ref. O&M plan, Framework, and Key Uncertainty Reference Number 5)

Monitoring Parameter	Final Performance Criteria Used to Determine Project Success	Interim Performance Criteria	Potential Corrective Actions or Mid-Course Corrections*
Area of potential nesting habitat for ground-nesting birds (terns and skimmers)	At year 10 post-construction, 0.5 ± 0.5 acres of select habitat will have less than 10 percent emergent vegetation.	At year 3 post-construction, information gathered to inform invasive vegetation removal and limestone supplementation.	Eradicate unwanted vegetation; expose bare ground/rock through mechanical methods. (Ref. O&M plan, Framework, and Key Uncertainty Reference Number 5)
Nesting Activity	Year 10: Brown pelican: at least 1,500 nests; gulls: at least 2,000 nests; wading birds: at least 250 nests; terns and skimmers: at least 100 nests.	Year 1: Brown pelican: as high as 250 nests; gulls: as high as 500 nests; wading birds: 0 nests; terns and skimmers: as high as 400 nests. Year 3: Brown pelican: at least 750 nests; gulls: at least 1,000 nests; wading birds: at least 75 nests; terns and skimmers: at least 300 nests. Year 5: Brown pelican: at least 1,000 nests; gulls: at least 1,500 nests; wading birds: at least 150 nests; terns and skimmers: at least 200 nests.	No corrective action is envisioned at Year 1 as the habitat is evolving for optimal bird use. That stated, unforeseen situations can be addressed utilizing adaptive management (Ref. O&M plan and Framework) Years 2, 4, 6, and 11: Brown pelican and wading birds: Additional preferred native vegetation plantings; eradicate unwanted vegetation; construction of artificial nesting platforms. In addition, in Year 5, rock dike modification may be needed (i.e., lower elevation as it relates to the interior island elevation prior to Year 6 nesting season). Terns and Skimmers: Eradicate unwanted vegetation; supplement limestone or expose bare ground through mechanical methods prior to the nesting season. Predator control will be implemented as needed utilizing established methods. (Ref. O&M plan, Framework, and Key Uncertainty Reference Numbers 3, 4, and 5)

5 Monitoring Schedule

The project monitoring schedule (Table 4) is separated by monitoring activities. Pre-execution monitoring will occur before project execution, if applicable. Execution of monitoring will occur when the Project has been fully executed as planned, although this timeframe may vary for different parameters. Performance monitoring will occur in the years following initial project execution (Years 1-10).

Table 4. Monitoring Schedule.

Table Note: X denotes required data acquisitions.

Monitoring Parameters	**Pre-Execution Monitoring**	**Execution Monitoring (initial) As-built (Year 0)**	**Post-Execution Monitoring (ongoing) Year 1**	**Post-Execution Monitoring (ongoing) Year 2**	**Post-Execution Monitoring (ongoing) Year 3**	**Post-Execution Monitoring (ongoing) Year 4**	**Post-Execution Monitoring (ongoing) Year 5**	**Post-Execution Monitoring (ongoing) Year 10**
CWB Aerial Nest Surveys	n/a	n/a	X	n/a	X	n/a	X	X
Vegetation Surveys	n/a	n/a	X	n/a	X	n/a	X	X
Near Vertical Aerial Imagery	n/a	n/a	X	n/a	X	n/a	X	X

6 Data Management

6.1 Data Deliverables

CWB Nest Aerial Surveys: LA TIG representatives will receive copies of all data generated (e.g., survey tracks, survey photographs that coincide with those tracks, GIS files, KMZ files, associated metadata) in association with the four scheduled sampling events (Post-construction Years 1, 3, 5, and 10, with confirmatory assessments at 20 years). Due to the bimodal nature of CWB nesting, each sampling event consists of two individual aerial surveys (Survey #1: mid-May and Survey #2: mid-June). Future surveys will be implemented following previous survey windows conducted in 2010 to 2013, 2015, 2018 and 2021 in Louisiana.

CWB Nest Dotting Analyses: LA TIG representatives will receive an individual data analysis summary report for each of the four scheduled CWB Nest Aerial Survey sampling events (Post-construction Years 1, 3, 5, and 10, with confirmatory assessments at 20 years). Reports will include all data collected and analyses performed as well as all associated metadata.

Vegetative Surveys: LA TIG representatives will receive an individual summary report for each of the four scheduled sampling events (Post-construction Years 1, 3, 5, and 10). Reports will include all data collected and analyses performed as well as all associated metadata.

6.2 Data Description

To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hard copy datasheets and notebooks and photographs will be retained by the implementing Trustee.

Relevant project data that are handwritten on hard copy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries be scanned to PDF files. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance/quality control [QA/QC] procedures, and other information about data such as meaning, relationships to other data, origin, usage, and format—can reference different documents)

6.3 Data Review and Clearance

Data will be reviewed for QA/QC in accordance with the *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0*, and any errors in transcription will be corrected. Implementing Trustees will verify and validate data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format and labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with implementing Trustee agency requirements.

After all identified errors are addressed, data are considered to be cleared. The implementing Trustee will give the other LA TIG members time to review the data before making such information publicly available (as described below). Before submitting the monitoring data and

information package, co-implementing Trustees shall confirm with one another that the package is approved for submission.

6.4 Data Storage and Accessibility

Once data have been cleared, they will be submitted to the designated AWS server which can be accessed through the Restoration Portal.

Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than 1 year from when data are collected.

6.5 Data Sharing

Data will be made publicly available in accordance with the Federal Open Data Policy through the designated AWS server, which can be accessed through DIVER Explorer Interface within 1 year of when the data collection occurred.

7 Reporting

Based on the project monitoring schedule (Section 5), associated reporting will be submitted in Years 2, 4, 6, and 11, and a record of the confirmatory assessments at 20 years. Reports have been scheduled for the year after major data collection efforts with the intention that results will be available to determine performance criteria that have been established in Table 3. If performance criteria have not been met, then potential corrective actions will be identified.

8 Roles and Responsibilities

The LA TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the Trustee Council or Cross-LA TIG MAM work group. LDWF is the implementing Trustee for the Project. The U.S. Department of the Interior will be the lead federal agency for conducting the environmental evaluation and compliance review for implementation. CPRA is a project partner. The implementing Trustees' roles include:

- Coordinating with the project partner to ensure data collection and report composition are completed
- Ensuring the project partner performs O&M activities as required
- Providing project progress information to the LA TIG

9 Monitoring and Adaptive Management Budget

The overall budget for the project monitoring and adaptive management is $2,770,385, and includes CWB aerial nest surveys, CWB nesting dotting efforts, vegetation surveys, near vertical aerial imagery acquisition and habitat mapping, vegetation species removal, invasive vegetation species removal, predator control, anthropogenic disturbance funds, artificial nesting structures, and oversight costs (Table 5).

Table 5. Monitoring and Adaptive Management Budget.

Cost Items	Frequency	Cost Estimates
CWB Aerial Nest Surveys and Nest Dotting	Years 1, 3, 5, 10	$2,035,385
Vegetation Surveys	Years 1, 3, 5, 10	$400,000
Vegetation Species Removal	Annual	$25,000

Cost Items	Frequency	Cost Estimates
Invasive Vegetation Species Removal	Annual	$25,000
Predator Control	Annual	$50,000
Anthropogenic Disturbance	Annual	$50,000
Artificial Nesting Structures	As needed	$10,000
LDWF Oversight	Throughout MAM Plan Implementation	$175,000
TOTAL	n/a	$2,770,385

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11 MAM Plan Revision History

Table 6. MAM Plan Revision History.

Old Version #	Revision Date	Changes Made	Reason for Change	New Version #
-	-	-	-	-

Attachment 1: Bird Colony Aerial Photography Protocol (RG Ford and The Water Institute of the Gulf)

High resolution, low altitude, oblique aerial photographic surveys will be used to census waterbird colonies along the Louisiana shoreline based on previous colony photographic surveys (2010 to 2013, 2015, 2018, and 2021) following the DWH oil spill. The list of colonies visited will be informed based on the most recent survey. The list will be adjusted after each survey session, adding newly discovered colonies and removing any former colonies at small islands that are found to be under water. Colonies containing only cryptic beach nesting birds, such as least terns, are not included.

Colony photographic surveys will be carried out from a fixed wing aircraft configured so that two photographers can work simultaneously. Photographers will be familiar with both aerial survey protocols and colony counting methodology so that they can determine immediately whether or not photograph quality is adequate for purposes of counting. Digital SLR cameras equipped with 18-200 and 200-300 mm telephoto lenses will be used to acquire photographs. Aircraft waypoints and time will be recorded automatically at 5 second or shorter intervals. Photograph time (recorded as part of the JPG file) will be used to estimate the position of each photograph.

Crews will consist of a pilot, a navigator/data recorder, and two photographers. The navigator will coordinate the sequence of colony visits and optimal aerial approach to each colony with the pilot. One photographer will take ‘context’ photographs showing a relatively wide area view of the colony while the other photographer will concentrate on more detailed close-up shots that will be used for counting. If time allows, the context photographer also will zoom in to obtain additional close-up photographs. The navigator will record when the aircraft is approaching a colony, when it is leaving, and the range of frame numbers shot over that colony.

As the aircraft approaches a target colony, the crew will assess the spatial distribution of birds on the colony. Photographers, navigator, and pilot will confer to determine the best angle of approach and the ideal altitude for photographic census. Their decision will be based on the shape of the colony, the species present at the colony, the strength and direction of the wind, vegetation around the colony, and angle of the sun. While the approach altitude is variable, all photography will be carried out at an altitude between 750-1,000 ft Above (mean) Sea Level (ASL), adjusted so that birds present on the colony do not leave their nests. Multiple approaches from different directions or altitudes may be made if photographers determine they are not obtaining photographs of adequate quality or if birds appear to be responding to the presence of the aircraft.

A high altitude (1,500 to 3,000 ft ASL) overview photographic survey will also be implemented using an accepted method (Colibri 2022). Use of a gyroscopically stabilized fixed camera mount will result in an image that is taken at a near-perpendicular aspect relative to the ground. Further, GPS location of each photograph will be recorded to metadata using a commercial GPS receiver affixed to the camera.

All photograph files (JPGs) will be downloaded daily to an external backup device. Flash memory cards from the cameras will be labeled and stored when they are full. Photographs of each individual colony will be inspected for clarity, location within the colony, and extent of colony coverage. If better photographs are required for a particular colony and if survey logistics allow, a colony may be visited a second time during a survey session.

Attachment 2: Bird Quantification (i.e., Dotting) Protocol (RG Ford and The Water Institute of the Gulf)

For most species, photographs from May surveys will represent peak breeding numbers and will be selected for future analysis. For some species, especially black skimmer, photos from June surveys will better represent peak numbers and will be used for analysis. Occasionally, especially for brown pelican, royal tern, and sandwich tern, well-developed colonies will be counted using May photographs, but additional large nesting groups that form after the May survey will be counted from June photographs and summed with May counts for a total number of nests.

All high altitude overview photographs will be inspected for clarity, location within the colony, and extent of colony coverage. Those best suited will be post processed using established georeferencing methods and mosaicked into a high resolution base mapping resource (Chapman and Wieczorek 2020). Representative low altitude aerial photographs will then be georeferenced using the high resolution, high altitude mosaic as an orientating layer thereby resulting in a singular imagery resource (a mosaic of high resolution photos for a given colony location) that is capable of supporting future analyses (i.e., nest dotting, characterizing bird / habit relationships, habitat evaluations, etc.).

Nest dotting analyses encompass the manual marking (dotting) of nests and birds (Ford 2010) within the mosaic of high resolution, low altitude, oblique aerial photographs; an ArcGIS-based platform. Upon completion, all dotting results are automatically displayed within a designated point count window. By design, the template standardizes both the feature domain and symbology of species and bird/nest delineations. Although the primary objective will be to determine number of nests, individual birds and chicks of each species will be counted in each photograph.

For brown pelican, nests will be categorized by their stage of development. These categories will include the following:

- Well-built nest (with attending adult and with or without chicks)
- Poorly built nest (pre-egg laying)
- Nest with chicks but without attending adults
- Abandoned nest (with eggs but unattended)
- Empty nest (early-season unattended without eggs or chicks)
- Brood (dependent chicks away from an obvious nest and not attended by an adult)

Together, these categories will provide numbers of pelican nests and breeding pairs at each colony based usually on a single aerial photographic survey even though egg-laying dates may span a period of months. For other species, all nests and territories will be marked more generally as “sites.” The detailed nest categories that will be used for brown pelicans are inappropriate for other species because of their small size (terns and gulls), scrape-nesting habits (terns and skimmers), or partial concealment by vegetation (waders and gulls).

Where overlapping images are used to analyze portions of a colony, one or more lines will be drawn on the selected image to delineate the area to be counted using that image. Areas outside any such lines will then be counted using different images. This process will continue until the colony is counted completely with available photographs.

Compiling Data

Manual nest dotting analyses are implemented and maintained within an ArcGIS-based platform. Tally of designated nest categories and related metadata are manually tabulated within a Microsoft® Access database.

Assessing Colony Conditions

Each analyzed image will be evaluated to characterize conditions at each colony. Factors that will be considered will include the following:

- The stage of the breeding cycle (e.g., early-, mid-, or late-incubation; early chick-rearing) for each species.
- Habitat occupancy (numerical and geographic extent to which each species occupied the habitat).
- Reproductive performance (e.g., pattern of abandonment, if any, chick production).
- Information specific to a particular image will be entered into a notes field in the main data table in the Access database. Information concerning the colony as a whole will be entered in a separate data table in the same database.

Data Summary Report

For each sampling event, the contractor will complete a data summary report, which will identify/quantify (where applicable) the following endpoints:

- Species and number of individuals/species encountered/colony
- Number of nests by species/colony
- Nest status by species/colony
- Contractor observations that may provide the LA TIG with insight into current and future avian restoration projects and/or adaptive management strategies

The contractor will provide designated LA TIG representatives with an individual, georegistered digital mapping product (i.e., photo mosaic) that clearly identifies counting subregions for each colony evaluated during photographic counting analyses.

Appendix B. Guidelines for NEPA Impact Determinations

Table B-1. Guidelines for NEPA Impact Determination on Physical Resources.

Resource	Impact Duration	Minor Impact Intensity Definitions	Moderate Impact Intensity Definitions	Major Impact Intensity Definitions
Geology and Substrates	Short-term: During construction period. Long-term: Over the life of the project or longer.	Disturbance to geologic features or soils could be detectable but could be small and localized. There could be no changes to local geologic features or soil characteristics. Erosion and/or compaction could occur in localized areas.	Disturbance could occur over local and immediately adjacent areas. Impacts to geology or soils could be readily apparent and result in changes to the soil character or local geologic characteristics. Erosion and compaction impacts could occur over local and immediately adjacent areas.	Disturbance could occur over a widespread area. Impacts to geology or soils could be readily apparent and could result in changes to the character of the geology or soils over a widespread area. Erosion and compaction could occur over a widespread area. Disruptions to substrates or soils may be permanent.
Hydrology and Water Quality	Short-term: During construction period. Long-term: Over the life of the project or longer.	Hydrology: The effect on hydrology could be measurable, but it could be small and localized. The effect could only temporarily alter the area's hydrology, including surface and ground water flows. Water quality: Impacts could result in a detectable change to water quality, but the change could be expected to be small and localized. Impacts could quickly become undetectable. State water quality standards as required by the Clean Water Act could not be exceeded. Floodplains: Impacts may result in a detectable change to natural and beneficial floodplain values, but the change could be expected to be small and localized. There could be no appreciable increased risk of flood loss including impacts on human safety, health, and welfare. Wetlands: The effect on wetlands could be measurable but small in terms of area and the nature of the impact. A small impact on the size, integrity, or connectivity could occur; however, wetland function could not be affected, and natural restoration could occur if left alone.	Hydrology: The effect on hydrology could be measurable, but small and limited to local and adjacent areas. The effect could permanently alter the area's hydrology, including surface and ground water flows. Water quality: Effects to water quality could be observable over a relatively large area. Impacts could result in a change to water quality that could be readily detectable and limited to local and adjacent areas. Change in water quality could persist; however, it could likely not exceed state water quality standards as required by the Clean Water Act. Floodplains: Impacts could result in a change to natural and beneficial floodplain values and could be readily detectable but limited to local and adjacent areas. Location of operations in floodplains could increase risk of flood loss, including impacts on human safety, health, and welfare. Wetlands: The action could cause a measurable effect on wetlands indicators (size, integrity, or connectivity) or could result in a permanent loss of wetland acreage across local and adjacent areas. However, wetland functions could only be permanently altered in limited areas.	Hydrology: The effect on hydrology could be measurable and widespread. The effect could permanently alter hydrologic patterns including surface and ground water flows. Water quality: Impacts could likely result in a change to water quality that could be readily detectable and widespread. Impacts could likely result in exceedance of state water quality standards and/or could impair designated uses of a water body. Floodplains: Impacts could result in a change to natural and beneficial floodplain values that could have substantial consequences over a widespread area. Location of operations could increase risk of flood loss, including impacts on human safety, health, and welfare. Wetlands: The action could cause a permanent loss of wetlands across a widespread area. The character of the wetlands could be changed so that the functions typically provided by the wetland could be permanently lost.
Air Quality	Short-term: During construction period. Long-term: Over the life of the project or longer.	The impact on air quality may be measurable, but could be localized and temporary, such that the emissions do not exceed the Environmental Protection Agency's (EPA's) de minimis criteria for a general conformity determination under the Clean Air Act (40 CFR § 93.153).	The impact on air quality could be measurable and limited to local and adjacent areas. Emissions of criteria pollutants could be at EPA's de minimis criteria levels for general conformity determination.	The impact on air quality could be measurable over a widespread area. Emissions are high, such that they could exceed EPA's de minimis criteria for a general conformity determination.
Noise	Short-term: During construction period. Long-term: Over the life of the project.	Increased noise could attract attention, but its contribution to the soundscape would be localized and unlikely to affect current user activities.	Increased noise could attract attention and contribute to the soundscape including in local areas and those adjacent to the action but could not dominate. User activities could be affected.	Increased noise could attract attention and dominate the soundscape over widespread areas. Noise levels could eliminate or discourage user activities.

Table B-2. Guidelines for NEPA Impact Determination on Biological Resources.

Resource	Impact Duration	Minor Impact Intensity Definitions	Moderate Impact Intensity Definitions	Major Impact Intensity Definitions
Habitats	Short-term: Lasting less than two growing seasons. Long-term: Lasting longer than two growing seasons.	Impacts on native vegetation may be detectable but could not alter natural conditions and could be limited to localized areas. Infrequent disturbance to individual plants could be expected but would not affect local or rangewide population stability. Infrequent or insignificant one-time disturbance to locally suitable habitat could occur, but sufficient habitat could remain functional at both the local and regional scales to maintain the viability of the species. Opportunity for increased spread of non-native species could be detectable but temporary and localized and could not displace native species populations and distributions.	Impacts on native vegetation could be measurable but limited to local and adjacent areas. Occasional disturbance to individual plants could be expected. These disturbances could affect local populations negatively but could not be expected to affect regional population stability. Some impacts might occur in key habitats, but sufficient local habitat could retain function to maintain the viability of the species both locally and throughout its range. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas but could only result in temporary changes to native species population and distributions.	Impacts on native vegetation could be measurable and widespread. Frequent disturbances of individual plants could be expected, with negative impacts to both local and regional population levels. These disturbances could negatively affect rangewide population stability. Some impacts might occur in key habitats, and habitat impacts could negatively affect the viability of the species both locally and throughout its range. Actions could result in the widespread increase of non-native species, resulting in broad and permanent changes to native species populations and distributions.
Wildlife Species (Including Birds)	Short-term: Lasting up to two breeding seasons, depending on length of breeding season. Long-term: Lasting more than two breeding seasons.	Impacts to native species, their habitats, or the natural processes sustaining them could be detectable, but localized, and could not measurably alter natural conditions. Infrequent responses to disturbance by some individuals could be expected, but without interference to feeding, reproduction, resting, migrating, or other factors affecting population levels. Small changes to local population numbers, population structure, and other demographic factors could occur. Sufficient habitat could remain functional at both the local and rangewide scales to maintain the viability of the species. Opportunity for increased spread of non-native species could be detectable but temporary and localized, and these species could not displace native species populations and distributions.	Impacts on native species, their habitats, or the natural processes sustaining them could be measurable but limited to local and adjacent areas. Occasional responses to disturbance by some individuals could be expected, with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local population levels. Some impacts might occur in key habitats. However, sufficient population numbers or habitat could retain function to maintain the viability of the species both locally and throughout its range. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas but could only result in temporary changes to native species population and distributions.	Impacts on native species, their habitats, or the natural processes sustaining them could be detectable and widespread. Frequent responses to disturbance by some individuals could be expected, with negative impacts to feeding, reproduction, migrating, or other factors resulting in a decrease in both local and rangewide population levels and habitat type. Impacts could occur during critical periods of reproduction or in key habitats and could result in direct mortality or loss of habitat that might affect the viability of a species. Local population numbers, population structure, and other demo-graphic factors might experience large changes or declines. Actions could result in the widespread increase of non-native species resulting in broad and permanent changes to native species populations and distributions.

Resource	Impact Duration	Minor Impact Intensity Definitions	Moderate Impact Intensity Definitions	Major Impact Intensity Definitions
Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms)	Short-term: Lasting up to two spawning seasons, depending on length of season. Long-term: Lasting more than two spawning seasons.	Impacts could be detectable and localized but small. Disturbance of individual species could occur; however, there could be no change in the diversity or local populations of marine and estuarine species. Any disturbance could not interfere with key behaviors such as feeding and spawning. There could be no restriction of movements daily or seasonally. Opportunity for increased spread of non-native species could be detectable but temporary and localized and these species could not displace native species populations and distributions.	Impacts could be readily apparent and result in a change in marine and estuarine species populations in local and adjacent areas. Areas being disturbed may display a change in species diversity; however, overall populations could not be altered. Some key behaviors could be affected but not to the extent that species viability is affected. Some movements could be restricted seasonally. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas but could only result in temporary changes to native species population and distributions.	Impacts could be readily apparent and could substantially change marine and estuarine species populations over a widescale area, possibly river-basin-wide. Disturbances could result in a decrease in fish species diversity and populations. The viability of some species could be affected. Species movements could be seasonally constrained or eliminated. Actions could result in the widespread increase of non-native species resulting in broad and permanent changes to native species populations and distributions.
Protected Species	Short-term: Lasting up to one Breeding/growing season. Long-term: Lasting more than one breeding/growing season.	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable, but small and localized, and could not measurably alter natural conditions. Impacts could likely result in a “may affect, not likely to adversely affect” determination for at least one listed species.	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable and some alteration in the numbers of protected species or occasional responses to disturbance by some individuals could be expected, with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local and adjacent population levels. Impacts could occur in key habitats, but sufficient population numbers or habitat could remain functional to maintain the viability of the species both locally and throughout their range. Some disturbance to individuals or impacts to potential or designated critical habitat could occur. Impacts could likely result in a “may affect, likely to adversely affect” determination for at least one listed species. No adverse modification of critical habitat could be expected.	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable, widespread, and permanent. Substantial impacts to the population numbers of protected species, or interference with their survival, growth, or reproduction could be expected. There could be impacts to key habitat, resulting in substantial reductions in species numbers. Results in an “is likely to jeopardize proposed or listed species/adversely modify proposed or designated critical habitat (impairment)” determination for at least one listed species.

Table B-3. Guidelines for NEPA Impact Determinations on Socioeconomic Resources.

Resource	Impact Duration	Minor Impact Intensity Definitions	Moderate Impact Intensity Definitions	Major Impact Intensity Definitions
Socioeconomics and Environmental Justice	Short-term: During construction period. Long-term: Over the life of the project or longer.	A few individuals, groups, businesses, properties, or institutions could be affected. Impacts could be small and localized. These impacts are not expected to substantively alter social and/or economic conditions. Actions could not disproportionately affect minority and low-income populations.	Many individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily apparent and detectable in local and adjacent areas and could have a noticeable effect on social and/or economic conditions. Actions could disproportionately affect minority and low-income populations. However, the impact could be temporary and localized.	A large number of individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily detectable and observed, extend over a widespread area, and have a substantial influence on social and/or economic conditions. Actions could disproportionately affect minority and low-income populations, and this impact could be permanent and widespread.
Cultural Resources	Short-term: During construction period. Long-term: Over the life of the project or longer.	The disturbance of a site(s), building, structure, or object could be confined to a small area with little, if any, loss of important cultural information potential.	Disturbance of a site(s), building, structure, or object not expected to result in a substantial loss of important cultural information.	Disturbance of a site(s), building, structure, or object could be substantial and may result in the loss of most or all its potential to yield important cultural information.
Infrastructure	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could affect public services or utilities, but the impact could be localized and within operational capacities. There could be negligible increases in local daily traffic volumes resulting in perceived inconvenience to drivers but no actual disruptions to traffic.	The action could affect public services or utilities in local and adjacent areas and the impact could require the acquisition of additional service providers or capacity. Detectable increase in daily traffic volumes (with slightly reduced speed of travel), resulting in slowed traffic and delays, but no change in level of service (LOS). Short service interruptions (temporary closure for a few hours) to roadway and railroad traffic could occur.	The action could affect public services or utilities over a widespread area resulting in the loss of certain services or necessary utilities. Extensive increase in daily traffic volumes (with reduced speed of travel) resulting in an adverse change in LOS to worsened conditions. Extensive service disruptions (temporary closure of one day or more) to roadways or railroad traffic could occur.
Land and Marine Management	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could require a variance or zoning change or an amendment to a land use, area comprehensive, or management plan, but could not affect overall use and management beyond the local area.	The action could require a variance or zoning change or an amendment to a land use, area comprehensive, or management plan, and could affect overall land use and management in local and adjacent areas.	The action could cause permanent changes to and conflict with land uses or management plans over a widespread area.
Tourism and Recreational Use	Short-term: During construction period. Long-term: Over the life of the project or longer.	There could be partial developed recreational site closures to protect public safety. The same site capacity and visitor experience could remain unchanged after construction. The impact could be detectable and/or could only affect some recreationists. Users could likely be aware of the action but changes in use could be slight. There could be partial closures to protect public safety. Impacts could be local. There could be a change in local recreational opportunities; however, it could affect relatively few visitors or could not affect any related recreational activities.	There could be complete site closures to protect public safety. However, the sites could be reopened after activities occur. There could be slightly reduced site capacity. The visitor experience could be slightly changed but still available. The impact could be readily apparent and/or could affect many recreationists locally and in adjacent areas. Users could be aware of the action. There could be complete closures to protect public safety. However, the areas could be reopened after activities occur. Some users could choose to pursue activities in other available local or regional areas.	All developed site capacity could be eliminated because developed facilities could be closed and removed. Visitors could be displaced to facilities over a widespread area and visitor experiences could no longer be available in many locations. The impact could affect most recreationists over a widespread area. Users could be highly aware of the action. Users could choose to pursue activities in other available regional areas.

Resource	Impact Duration	Minor Impact Intensity Definitions	Moderate Impact Intensity Definitions	Major Impact Intensity Definitions
Fisheries and Aquaculture	Short-term: During construction period. Long-term: Over the life of the project or longer.	A few individuals, groups, businesses, properties, or institutions could be affected. Impacts could be small and localized. These impacts are not expected to substantively alter social and/or economic conditions.	Many individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily apparent and detectable in local and adjacent areas and could have a noticeable effect on social and/or economic conditions.	A large number of individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily detectable and observed, extend over a widespread area, and could have a substantial influence on social and/or economic conditions.
Marine Transportation	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could affect public services or utilities, but the impact could be localized and within operational capacities. There could be negligible increases in local daily marine traffic volumes, resulting in perceived inconvenience to operators but no actual disruptions to transportation.	The action could affect public services or utilities in local and adjacent areas, and the impact could require the acquisition of additional service providers or capacity. Detectable increase in daily marine traffic volumes could occur (with slightly reduced speed of travel), resulting in slowed traffic and delays. Short service interruptions could occur (temporary delays for a few hours).	The action could affect public services utilities over a widespread area resulting in the loss of certain services or necessary utilities. Extensive increase in daily marine traffic volumes could occur (with reduced speed of travel), resulting in extensive service disruptions (temporary closure of one day or more).
Aesthetics and Visual Resources	Short-term: During construction period. Long-term: Over the life of the project or longer.	There could be a change in the view shed that was readily apparent but could not attract attention, dominate the view, or detract from current user activities or experiences.	There could be a change in the view shed that was readily apparent and attracts attention. Changes could not dominate the viewscape, although they could detract from the current user activities or experiences.	Changes to the characteristic views could dominate and detract from current user activities or experiences.
Public Health and Safety, Including Flood and Shoreline Protection	Short-term: During construction period. Long-term: Over the life of the project or longer.	Actions could not result in 1) soil, ground water, and/or surface water contamination; 2) exposure of contaminated media to construction workers or transmission line operations personnel; and/or 3) mobilization and migration of contaminants currently in the soil, ground water, or surface water at levels that could harm the workers or general public. Increased risk of potential hazards (e.g., increased likelihood of storm surge) to visitors, residents, and workers from decreased shoreline integrity could be temporary and localized.	Project construction and operation could result in 1) exposure, mobilization and/or migration of existing contaminated soil, ground water, or surface water to an extent that requires mitigation; and/or 2) could introduce detectable levels of contaminants to soil, ground water, and/or surface water in localized areas within the project boundaries such that mitigation/remediation is required to restore the affected area to the preconstruction conditions. Increased risk of potential hazards to visitors, residents, and workers from decreased shoreline integrity could be sufficient to cause a permanent change in use patterns and area avoidance in local and adjacent areas.	Actions could result in 1) soil, ground water, and/or surface water contamination at levels exceeding federal, state, or local hazardous waste criteria, including those established by 40 CFR § 261; 2) mobilization of contaminants currently in the soil, ground water, or surface water, resulting in exposure of humans or other sensitive receptors such as plants and wildlife to contaminant levels that could result in health effects; and 3) the presence of contaminated soil, ground water, or surface water within the project area, exposing workers and/or the public to contaminated or hazardous materials at levels exceeding those permitted by the federal Occupational Safety and Health Administration (OSHA) in 29 CFR § 1910. Increased risk of potential hazards to visitors, residents, and workers from decreased shoreline integrity could be substantial and could cause permanent changes in use patterns and area avoidance over a widespread area.