Louisiana Trustee Implementation Group Draft Phase 2 Restoration Plan/Environmental Assessment #1.2:

Spanish Pass Ridge and Marsh Creation Project and Lake Borgne Marsh Creation Project

September 2019

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Section 1 Introduction

The Louisiana Trustee Implementation Group[1] (LA TIG) prepared this draft Phase 2 Restoration Plan /Environmental Assessment #1.2 (Phase 2 RP/EA #1.2) to restore and conserve habitat injured in the Louisiana Restoration Area as a result of the Deepwater Horizon (DWH) oil spill that occurred in 2010. 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) (DWH Trustees 2016a) and record of decision, Oil Pollution Act of 1990 (OPA), and the National Environmental Policy Act of 1969 (NEPA). This Phase 2 RP/EA #1.2 is consistent with the *Louisiana Trustee Implementation Group Final Restoration Plan #1: Restoration of Wetlands, Coastal, and Nearshore Habitats; Habitat Projects on Federally Managed Lands; and Birds* [hereafter Phase 1 Final RP] (LA TIG 2017). This plan is also consistent with the *Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the Deepwater Horizon (DWH) Oil Spill* (DWH Trustee Council, 2016). The Phase 2 RP/EA #1.2 considers design alternatives for the Barataria Basin Ridge and Marsh Creation Project Spanish Pass Increment (Spanish Pass project) and for the Lake Borgne Marsh Creation Project Increment One (Lake Borgne project), and identifies Preferred Design Alternatives for these projects that would best help compensate the public for impacts caused by the DWH oil spill in the Louisiana restoration area. The goal of these projects is to restore and conserve wetland, coastal, and nearshore habitats in the Louisiana Restoration Area (LA TIG 2017).

1.1 Background

This Phase 2 RP/EA #1.2 tiers from previous restoration planning efforts related to the DWH oil spill, as summarized in the Final PDARP/PEIS and the Phase 1 Final RP. Additional background on the ecosystem-scale impacts of the DWH oil spill, and the Trustees' selection of appropriate restoration approaches and techniques, can be found in the Final PDARP/PEIS at the URL via the following link: https://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Where appropriate, and summarized accordingly, this document incorporates by reference information contained in those previous restoration planning documents. Links to online versions of these documents are included with their respective citations in Section 10.

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. 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

[1] The Louisiana Trustee Implementation Group includes five Louisiana state trustee agencies and four federal trustee agencies: Coastal Protection and Restoration Authority (CPRA), Louisiana Department of Natural Resources (LDNR), Louisiana Department of Environmental Quality (LDEQ), Louisiana Oil Spill Coordinator's Office, Louisiana Department of Wildlife and Fisheries (LDWF), 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 (EPA).

engineering, design, and compliance) in one plan for a conceptual project. This would allow the TIG to develop information needed to fully consider a subsequent implementation phase of that project in a future restoration plan.

The LA TIG prepared the Phase 1 Final RP as a first-phase plan, selecting project alternatives[2] to undergo E&D, considering OPA screening criteria and Final PDARP/PEIS restoration goals, among others (see Sections 2 and 3 of Phase 1 Final RP) (LA TIG 2017). The Spanish Pass Project and the Lake Borgne Project were selected as project alternatives in the Phase 1 Final RP to be funded for E&D. The E&D for these projects is at a stage sufficient to conduct a NEPA analysis in a Phase 2 plan. As project alternatives were analyzed in the Phase 1 Final RP, only design alternatives are analyzed in this Phase 2 RP/EA #1.2.

1.2 OPA and NEPA 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 an incident involving an oil discharge or substantial threat of an oil discharge. Federal trustees must comply with NEPA, 42 U.S.C. § 4321 et seq., and its regulations, 40 Code of Federal Regulations (CFR) § 1500 et seq., and agency-specific NEPA regulations, when planning restoration projects.

DOI is the lead federal trustee for preparing this Phase 2 RP/EA #1.2, and the federal and state agencies of the LA TIG are acting as cooperating agencies, pursuant to NEPA. Each federal cooperating agency on the LA TIG intends to adopt the NEPA analysis in this Phase 2 RP/EA #1.2. Each 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.

1.3 Purpose and Need

To meet the purpose of contributing to the restoration of those natural resources and services injured in the Louisiana Restoration Area as a result of the DWH oil spill, the LA TIG conducts restoration planning and implementation. This Phase 2 RP/EA #1.2 is consistent with the Final PDARP/PEIS (DWH Trustees 2016a), which identifies extensive and complex injuries to natural resources and services across the Gulf of Mexico and a need and plan for comprehensive restoration consistent with OPA. This Phase 2 RP/EA #1.2 falls within the scope of the purpose and need identified in the Final PDARP/PEIS. As described in Section 5.3 of the Final PDARP/PEIS, the five Trustee programmatic restoration goals work independently and together to benefit injured resources and services. The programmatic goal addressed in this Phase 2 RP/EA #1.2 is to restore and conserve habitat. More specifically, this document addresses the "restore wetlands, coastal, and nearshore habitats" restoration type. Additional information about the purpose and need for DWH NRDA restoration can be found in Section 5.3.2 of the Final PDARP/PEIS (DWH Trustees 2016a).

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[2] Project alternatives are independent restoration projects that could be selected and implemented to address injuries as a result of the DWH oil spill. The word "project" and "project alternative" may be used interchangeably in this document. Design alternatives are different configurations of potential designs for a given project alternative that are analyzed and evaluated. After analysis, a "Preferred Alternative" is selected from the design alternatives and carried forward with a "Non-preferred Alternative" for OPA and NEPA analysis

1.3.1 Proposed Action

To address the purpose and need for action, the LA TIG proposes to undertake the final design and implementation of the TIG's preferred design alternatives for the Spanish Pass and Lake Borgne projects, using funds made available through the DWH Consent Decree. **Figure 1-1** shows each project's general location.

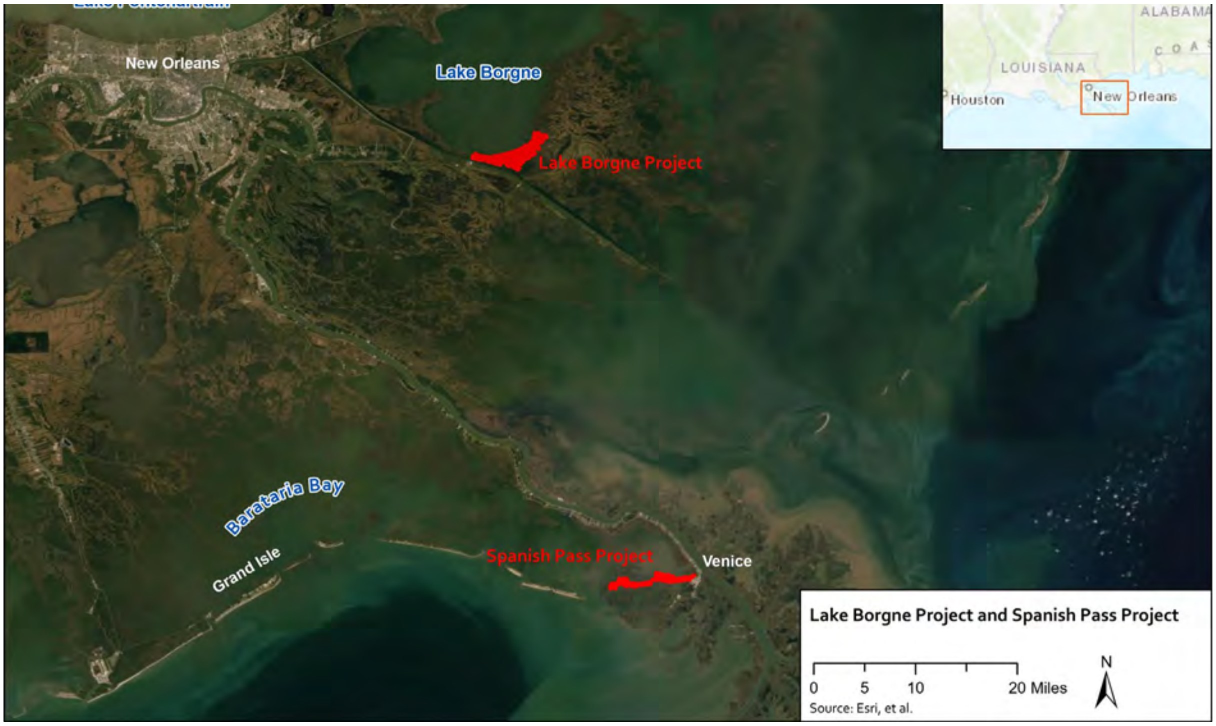

Figure 1-1. Geographic Setting for Lake Borgne Project and Spanish Pass Project.

Spanish Pass Project

The LA TIG addresses the programmatic restoration goal of restoring and conserving habitat by proposing implementation of the Spanish Pass Project Design Alternative 6A-Scenario 1, one of the LA TIG's Preferred Alternatives. Design Alternative 6A would meet the goal of restoring and conserving wetland, coastal, and nearshore habitats, by creating and nourishing ridge and marsh habitat that has been degraded due to sea-level rise, high subsidence rates, diminished sediment supply, and extreme storm events. The objective of the project is to create approximately 139 acres of ridge and 1,794 acres of marsh habitat designed for a 20-year project life. The ridge and marsh creation project would use an estimated 12.2 million cubic yards (MCY) of fill from Mississippi River borrow areas. The estimated total cost for this project is approximately $94,896,000, which is approximately $19M lower than the estimate in the Phase 1 Final RP, Table 4, and represents a higher total marsh creation area than envisioned in the Phase 1 Final RP. Further details on the design components of Design Alternative 6A are presented in Section 3.1.

Lake Borgne Project

The LA TIG also addresses the programmatic restoration goal of restoring and conserving habitat by proposing implementation of the Lake Borgne Project Design Alternative LB3, one of the LA TIG's Preferred Alternatives. Design Alternative LB3 would meet the goal of restoring and conserving wetland, coastal, and nearshore habitats, by creating and nourishing marsh habitat that has been degraded due to sea-level rise, high subsidence rates, diminished sediment supply, and extreme storm events. The objective of this project is to create approximately 2,935 acres of marsh habitat designed to establish habitat for a 20-year project life. This marsh creation project would utilize an estimated 13.0 million cubic yards (MCY) of fill from the Lake Borgne borrow area. Design Alternative LB3 addresses an area of marsh that has a greater potential for erosion due to the exposure of wind-driven waves, boat traffic, and deteriorating shoreline protection features. Further details on the design components of Design Alternative LB3 are presented in Section 3.2. The estimated total project cost for this project is approximately $101,815,000, which is approximately $26.6M less than the original estimate in the Phase 1 Final RP, Table 4, and includes substantially more acreage than envisioned in the Phase 1 Final RP.

Other Design Alternatives Analyzed in this Phase 2 RP/EA #1.2

In this document, the LA TIG evaluates a reasonable range of design alternatives, and includes the Spanish Pass Project Design Alternative 6B-Scenario 2 as a Non-preferred Alternative, which is considered in Section 3.1.2. The LA TIG also evaluates the Lake Borgne Project Design Alternative LB2 as a Non-preferred Alternative, which is considered in detail in Section 3.4.2.

No Action Alternative

No Action Alternatives must be considered to conform to NEPA requirements (40 CFR Part 1502.14(d)). No action alternatives are addressed for the Spanish Pass Project in Section 3.1.3 and for the Lake Borgne Project in Section 3.4.3.

Coordination with Other Gulf Restoration Programs

As discussed in Section 1.5.6 of the Final PDARP/PEIS and Section 2.1.3 of the Phase 1 Final RP, 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.

Severability of Projects

In this RP/EA, the LA TIG proposes to select preferred restoration alternatives with a total funding of approximately $197 million ($94.9 million for the Spanish Pass project alternative and $101.8 million for the Lake Borgne project alternative). The project alternatives are independent of each other and may be selected independently for implementation in this and/or future restoration plans by the LA TIG.

1.4 Public Involvement

Public input is an integral part of NEPA, OPA, and the DWH oil spill restoration planning effort. On January 23, 2017, the LA TIG posted in the Federal Register a Notice of Availability of the Draft Phase 1 RP for public review and comment (82 Federal Register 7884). The Spanish Pass Project and the Lake Borgne Project were in the plan proposed for E&D. After a 30-day public comment period, the Spanish Pass Project and the Lake Borgne Project were approved to be funded for E&D.

1.4.1 Public Review and Comment Opportunity for the Draft Phase 2 RP/EA #1.2

On June 22, 2018, the LA TIG posted a Notice of Intent on the NOAA Gulf Spill Restoration website, accessible at the URL via the following link: (https://www.gulfspillrestoration.noaa.gov/), informing the public that it was beginning to draft a restoration plan to restore wetlands, coastal, and nearshore habitats. The public is encouraged to review and comment on this Phase 2 RP/EA #1.2. It is being made available for public review and comment for 30 days following release as specified in the public notice published in the Federal and Louisiana Registers. To facilitate public comment, a public webinar is scheduled for October 28, 2019 at 4pm central time, as summarized in the NOA. Comments can be submitted during the comment period by one of following methods:

- Via the internet at the URL accessed using the following link: http://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana
- Via hard copy, write: U.S. Fish and Wildlife Service, P.O. Box 29649, Atlanta, GA 30345, submissions must be postmarked no later than 30 days after the release date of the draft Phase 2 RP/EA #1.2.
- Written comments will be accepted during the live webinar. Instructions for commenting during the webinar will be provided.

Next Steps

After the close of the public comment period, the LA TIG will consider all input received during the public comment period and finalize the Phase 2 RP/EA #1.2. A summary of comments received and the LA TIG's responses (where applicable) will be included in the final Phase 2 RP/EA #1.2. Following public review, the LA TIG will select a design alternative for each project and prepare for implementation, including final design and construction. If appropriate, DOI will prepare a finding of no significant impact (FONSI) that will be included in the final Phase 2 RP/EA # 1.2, which will be made available to the public.

Decisions to be Made

This document is intended to provide the public and decision makers with information and analysis on the LA TIG's proposal to proceed with the selection and implementation of preferred design alternatives for the Spanish Pass Project and the Lake Borgne Project. The environmental impacts of the selected design alternatives are assessed in this document. This Phase 2 RP/EA #1.2 and the corresponding opportunity for the public to review and comment on the document are intended to guide the LA TIG's selection of projects for implementation that best meet its purpose and need as described in Section 1.3 above.

1.4.2 Administrative Record

The DWH Trustees opened a publicly available Administrative Record for the DWH oil spill, which includes restoration planning activities, concurrently with publication of the 2010 Notice of Intent (pursuant to 15 CFR § 990.45). DOI is the lead federal trustee for maintaining the Administrative Record, which can be found at the URL via the following link: https://www.doi.gov/deepwaterhorizon/adminrecord. The LA TIG also uses this Administrative Record site for DWH restoration planning.

Information about restoration project implementation is being provided to the public through the Administrative Record and other outreach efforts, including at https://www.gulfspillrestoration.noaa.gov.

Section 2 Restoration Planning Process: *Project Screening and Alternatives*

2.1 Restoration Planning Process

Immediately following the DWH oil spill, the Trustees initiated an injury assessment pursuant to OPA, which 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 so that restoration can address the nature, degree, and extent of the injuries caused by the DWH oil spill.

2.1.1 Summary of Injuries addressed

Chapter 4 of the Final PDARP/PEIS summarizes the injuries from the DWH oil spill, including injuries to wetlands, nearshore and coastal habitats addressed by this plan. As a programmatic restoration plan, the Final PDARP/PEIS also provides direction and guidance for identifying, evaluating, and selecting future restoration projects to be carried out by the TIGs (Final PDARP/PEIS Chapter 7 and Section 5.10.4 [DWH Trustees 2016a]).

As summarized in the PDARP/PEIS, the Trustees documented that the waters, sediments, and marsh habitats in many locations in the northern Gulf of Mexico had concentrations of oil that were high enough to cause toxic effects. The degree and extent of these toxic concentrations varied by location and time. Exposure to oil and response activities resulted in extensive injuries to multiple habitats, species, and ecological functions across broad geographic regions. The DWH incident resulted in injuries to intertidal marsh habitats, including marsh plants and associated organisms. Given the extensive injuries to various marsh habitats in Louisiana, in the Phase 1 Final RP, the LA TIG decided to prioritize projects that would restore habitat injured by the DWH oil spill.

2.1.2 Phase 1 Final RP

Consistent with the 13 restoration types described in the Final PDARP/PEIS (DWH Trustees 2016a) and the Phase 1 Final RP, the LA TIG addressed restoration of wetlands, coastal, and nearshore habitats with these marsh creation projects. Additional information about the purpose and need for DWH NRDA restoration can be found on page 5-11 in Section 5.3.2 of the Final PDARP/PEIS (DWH Trustees 2016a). The Phase 1 Final RP analyzed a reasonable range of project alternatives anticipated to meet goals to restore wetlands, coastal, and nearshore habitats. In addition to the OPA standards, the LA TIG established and applied additional incident-specific evaluation and selection criteria (Phase 1 Final RP Section 2.2.1.3 [LA TIG 2017]).

In the Phase 1 Final RP, the LA TIG screened project alternatives at the conceptual design stage that could provide suitable habitats based on geographic location, immediacy, and sustainability of project benefits provided to the injured resources. Through this analysis, the LA TIG narrowed the range of alternatives to a suite of projects that is consistent with the restoration goals identified in the Final PDARP/PEIS. Of the 14 project alternatives fully evaluated according to OPA, the LA TIG selected 6 to undergo further E&D development:

- Rabbit Island Restoration Project
- Queen Bess Island Restoration Project
- Lake Borgne Marsh Creation: Increment One
- Barataria Basin Ridge and Marsh Creation: Spanish Pass Increment
- Terrebonne Basin Ridge and Marsh Creation: Bayou Terrebonne Increment
- Shoreline Protection at Jean Lafitte National Historical Park and Preserve

Section 2.2 of the Phase 1 Final RP describes the screening and evaluation process used to select projects for inclusion in Phase 2 restoration plans. The six selected project alternatives, including the Lake Borgne and Spanish Pass projects, were carried forward to E&D, during which design alternatives were further developed.

Screening of the project alternatives adheres to project selection criteria consistent with OPA regulations (15 CFR § 990.54), the Final PDARP/PEIS, and additional evaluation criteria established by the LA TIG (Phase 1 Final RP Section 2.2.1 [LA TIG 2017]). The OPA evaluation for the Spanish Pass Project and the Lake Borgne Project are herein incorporated by reference and can be found in the Phase 1 Final RP (LA TIG 2017). Design alternatives are further analyzed below.

2.1.3 Phase 2 RP/EA #1.2

The Spanish Pass Project and the Lake Borgne Project are at a sufficient stage in the E&D process to conduct meaningful OPA and NEPA analysis on the reasonable range of design alternatives. Therefore, the LA TIG initiated preparation of this Phase 2 RP/EA #1.2. As the remaining 3 selected projects progress through E&D, additional Phase 2 restoration plans are expected to be initiated for those projects at a later time.

2.2 OPA Evaluation of Design Alternatives

During conceptual and preliminary design, design alternatives were developed and evaluated for the Spanish Pass Project (Baird 2019) and the Lake Borgne Project (CPRA 2018a). The information contained in those reports is incorporated herein by reference.

The LA TIG applied each of the OPA evaluation standards (15 CFR § 990.54) to these design alternatives to affirm consistency with the initial OPA evaluation completed in the Phase 1 RP and determine how well each met the elements below. The OPA evaluation criteria included:

- The cost to carry out the design alternative
- The extent to which each design alternative is expected to meet the LA TIG’s goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses
- The likelihood of success of each design alternative
- The extent to which each design 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 design alternative benefits more than one natural resource and/or service

- The effect of each design alternative on public health and safety

2.2.1 Spanish Pass Project Design Alternatives

For the Spanish Pass Project, design alternatives with multiple design elements have been developed and refined over multiple phases of design. Descriptions of these alternatives can be found in the Barataria Basin Ridge and Marsh Creation Project Spanish Pass Increment Design Documentation Report (CPRA 2019) and the DWH Spanish Pass (BA-0203) – Conceptual Fill Nomenclature memorandum (Baird 2019). Each of the design alternatives consists of a marsh creation area (MCA) or marsh fill area footprint, ridge footprint, and borrow areas (**Figure 2-1**). Using combinations of these MCAs, ridge areas, and borrow areas, an initial evaluation was performed to uniformly and objectively assess these design alternatives. This evaluation included environmental, cultural resource and geotechnical data collection; development of design criteria; and assessment of potential borrow areas, access corridors and marsh fill area footprints.

Figure 2-1. Barataria Basin Ridge and Marsh Creation Project Spanish Pass Increment Area.

For the initial alternatives evaluation, the project area was divided into 69 numbered subareas, that were then combined to form design alternatives. These initial subareas are shown in **Figure 2-2**, and combinations of these subareas resulted in design alternatives 1, 2, 3, 4, and 5D, as summarized below. In each of these alternatives, borrow would come from a combination of Mississippi River and Grand Liard sources, depending on the proximity of the proposed MCAs to each of these sources.

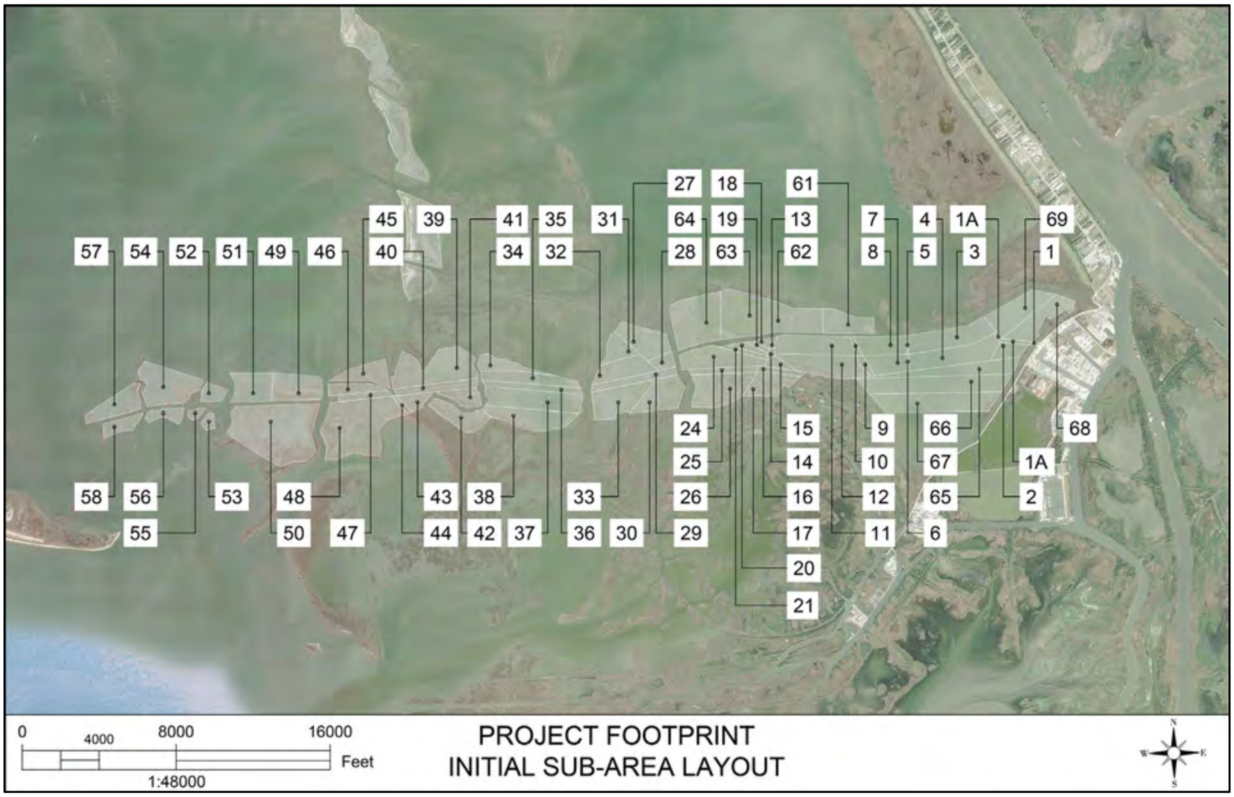

Figure 2-2. Barataria Basin Ridge and Marsh Creation Project Spanish Pass Increment Fill Subareas.

- **Design Alternative 1** proposes to build only the marsh creation areas north of Spanish Pass (subareas 54, 52, 51, 49, 46, 39, 35, 32, 28, 24, 21, 20, 19, 18, 13, 11, 9, 7, 5, and 3). This alternative would result in a total marsh creation area of 946 acres.
- **Design Alternative 2** proposes to build the marsh creation areas that are mostly south of Spanish Pass (subareas 50, 48, 44, 43, 41, 37, 33, 30, 25, 24, 16, 15, 14, 12, 10, 8, 6, 4, 2, and 1). This alternative would result in a total marsh creation area of 1,191 acres.
- **Design Alternative 3** proposes to build the most cost-effective cells (subareas 54, 50, 48, 44,43, 42, 41, 39, 38, 37, 33, 32, 31, 30, 28, 27, 26, 25, 24, 21, 20, 19, 18, 15, 14, 13, 12, 11, 10, 9 8, 7, 6, 5, 4, 3, 2 and 1), which are typically the largest cells and would result in a large marsh creation area of 2,167 acres.
- **Design Alternative 4** proposes to reduce the cost of Design Alternative 3 by removing subareas 39, 25, 18, 13, 11, 9, 7, 5, and 3, and adding subareas 34 and 35. This alternative would result in a total marsh creation area of 1,727 acres.
- **Design Alternative 5D** proposes to reduce the cost of Design Alternative 4 by removing subareas 34 and 35. Additionally, this alternative enlarged the eastern area, eliminated subarea 50, and removed subarea 54 due to concerns about degradation from wave exposure. This alternative would result in a total marsh creation area of 1,387 acres.

Between the 30% and 60% designs, additional geotechnical analysis revealed that soils in many of the proposed MCAs would be too weak to support earthen containment dikes (ECD) as proposed for many of the initial alternatives (Baird, 2019). This affected both the design as well as the appropriate borrow sources that could be utilized for marsh construction. As a result, the engineering team further refined the original list of alternatives and the borrow sources proposed. These refined alternatives were developed from 8 subareas, referred to as MCAs A-H, which represent a subset of the initial numbered subareas shown in Figure 2-2. **Figure 2-3** shows these revised subareas. The design alternatives developed from these subareas are described below, and summarized in Baird (2019).

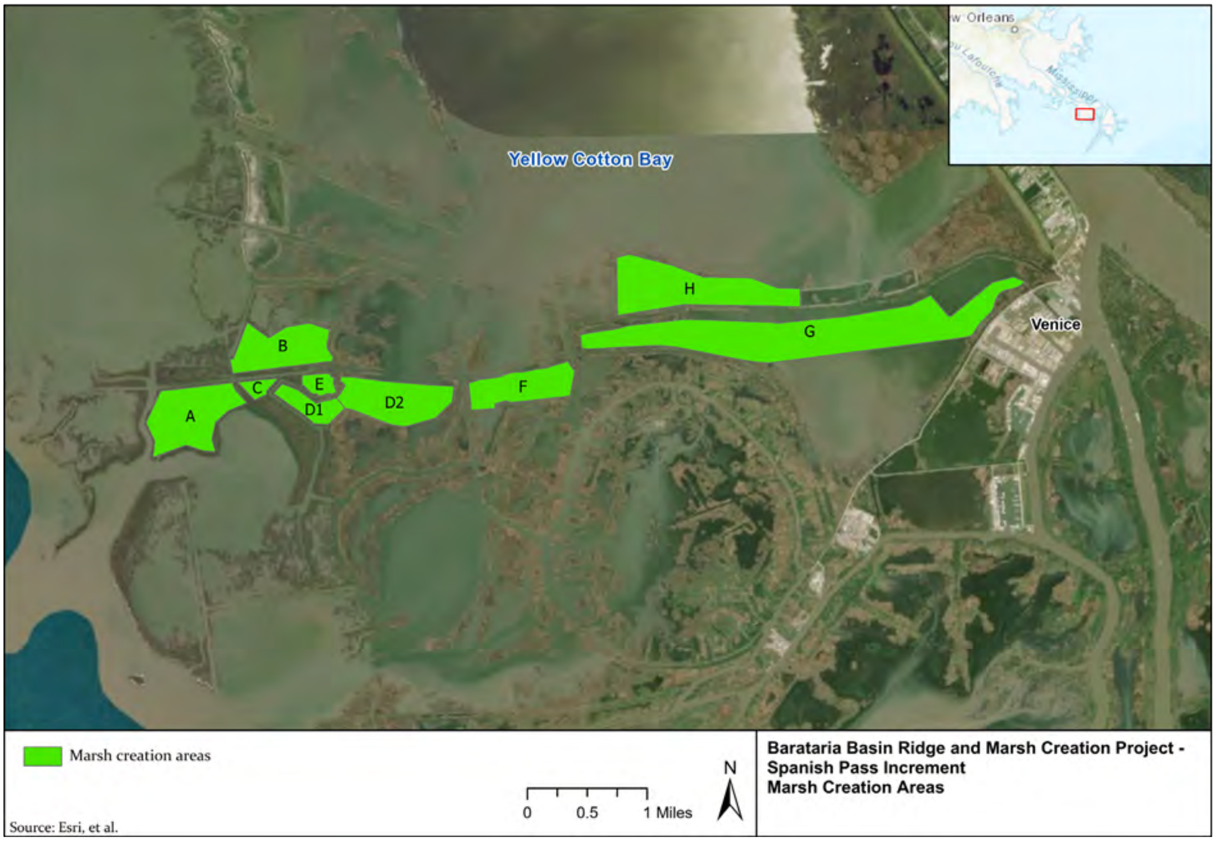

Figure 2-3. Revised Nomenclature for Marsh Creation Subareas (Baird, 2019).

- **Design Alternative 6A-Scenario 1** would result in a total marsh creation area of 1,794 acres. In this scenario, all of the revised subareas (A-H) would be constructed from Mississippi River borrow, under the assumption that fill from the Mississippi River borrow areas has less than 25% silt content so that ECDs will not be required to achieve the design marsh elevation. An 80’ sand ridge will be constructed on the northern border of MCAs D2, F, and G (**Figure 2-3**).
- **Design Alternative 6B-Scenario 2** has nearly the same MCA footprint as Alternative 6A-Scenario 1, with a small area near Venice removed. This alternative would result in a total marsh creation area of 1,661 acres. This alternative assumes that the Mississippi River borrow sources contain more than ~25% silt, which would require ECDs around MCAs B, D2, F, G, and H. Fill for these MCAs could then be provided from any borrow area but likely the Mississippi River, with the potential exception of MCA B coming from Grand Liard. MCA E, which would not require containment, would be filled with

sand from borrow area B2. Fill for MCAs A, C, and D1 could come from the Grand Liard borrow area, but would also require ECDs to be erected.

Additional details on each of these design alternatives are provided in the Barataria Basin Ridge and Marsh Creation Project Spanish Pass Increment Design Documentation Report (CPRA 2019) and Baird (2019), and are summarized in **Table 2-1**.

Table 2-1. Barataria Basin Ridge and Marsh Creation Project Spanish Pass Increment Design Alternatives.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5D	Alternative 6A	Alternative 6B
Description of fill area footprint	North of Spanish Pass	Mostly south of Spanish Pass	Uses largest subareas	Removed Subarea 39; added Subareas 34 and 35	Removed Subarea 50, 54, 34 and 35. Added subarea 39	MCAs A-H from revised subareas (Figure 2-3)	Similar to 6A; different assumptions re: ECDs
MCA acres	946	1,191	2,167	1,727	1,387	1,794	1,661
Ridge acres	49	64	69	69	116	139	271
Fill volume in cubic yards	10,522,000	11,259,000	20,763,000	16,292,000	14,600,000	12,210,000	14,603,000
Costs	$92,611,000	$101,435,000	$176,326,000	$144,605,000	$114,055,000	$94,896,000	$109,757,000
Cost/MCA acres	$97,897	$85,168	$81,369	$83,732	$82,231	$52,896	$66,078

All of the design alternatives were scored and ranked based on potential impacts to cultural resources, environmental resources (e.g., T&E Species, MBTA species, and EFH), hydrodynamics, infrastructure, navigation, and other metrics. For each impact area or resource, a score was assigned to each alternative. A value of 1 indicates the resource is not likely to be impacted. A value of 2 indicates that minor impacts are likely to occur but these impacts are expected to be temporary or can be appropriately mitigated by following standard permit conditions. A value of 3 indicates that more moderate impacts are likely to occur, and the design alternative would require more extensive consultation with resource agencies and possibly adjustments to minimize impacts and receive regulatory approvals.

Each of the design alternatives has minimal impacts to the physical, biological, and socioeconomic environment, since these factors were considered and minimized from the initial design stage for all alternatives. Furthermore, the only differences in environmental resources in the project area correspond with east-west gradients in salinity and geotechnical characteristics of the substrate. Since each of the design alternatives spans these east-west gradients, they all impact similar resources. Because there is no significant variability in environmental or infrastructure characteristics across the project domain, the individual impacts are identical and each of the design alternatives had the same final score (27) (see **Table 2-2**). As shown in **Table 2-1**, however, Alternatives 6A-Scenario 1 and 6B-Scenario 2 had substantially lower costs per unit acre relative to the other alternatives, and were therefore the alternatives carried forward for further analysis.

Table 2-2. Design Alternatives Scoring Matrix: Spanish Pass.

Evaluation Criteria	Alternative 1 Impact Scores	Alternative 2 Impact Scores	Alternative 3 Impact Scores	Alternative 4 Impact Scores	Alternative 5D Impact Scores	Alternative 6A* Impact Scores	Alternative 6B Impact Scores
Cultural Resources	1	1	1	1	1	1	1
T&E Species – Gulf Sturgeon	1	1	1	1	1	1	1
T&E Species – Pallid Sturgeon	1	1	1	1	1	1	1
T&E Species – West Indian Manatee	1	1	1	1	1	1	1
Colonial Nesting Birds/MBTA Species	1	1	1	1	1	1	1
Submerged Aquatic Vegetation	2	2	2	2	2	2	2
EFH	1	1	1	1	1	1	1
Water Quality/ Dissolved Oxygen	1	1	1	1	1	1	1
Wave Climate	1	1	1	1	1	1	1
Oysters	2	2	2	2	2	2	2
Other Wetland Impacts	2	2	2	2	2	2	2
Pipelines	3	3	3	3	3	3	3
Existing Shoreline Protection Features (Mississippi Levee System)	1	1	1	1	1	1	1
Transportation	1	1	1	1	1	1	1
Flood Protection Features	1	1	1	1	1	1	1
Oil and Gas Wells	3	3	3	3	3	3	3
Unexploded Ordnance	1	1	1	1	1	1	1
Navigation	3	3	3	3	3	3	3
Total Impact Score	**27**	**27**	**27**	**27**	**27**	**27**	**27**

*Preferred Alternative
MBTA – Migratory Bird Treaty Act; T&E – threatened and endangered

2.2.2 Lake Borgne Project Design Alternatives

Eight design alternatives with multiple design elements were developed for the Lake Borgne Project. A thorough and comprehensive evaluation was performed to uniformly and objectively assess these design alternatives as documented in the *Lake Borgne Marsh Creation Project Increment One (PO-0180) Alternatives Analysis Report* (CPRA 2018b). This evaluation included data collection; data gap analysis; preparation of design criteria; and assessment of potential borrow areas, access corridors, and marsh fill footprints. The design alternative features are presented in **Figure 2-4**.

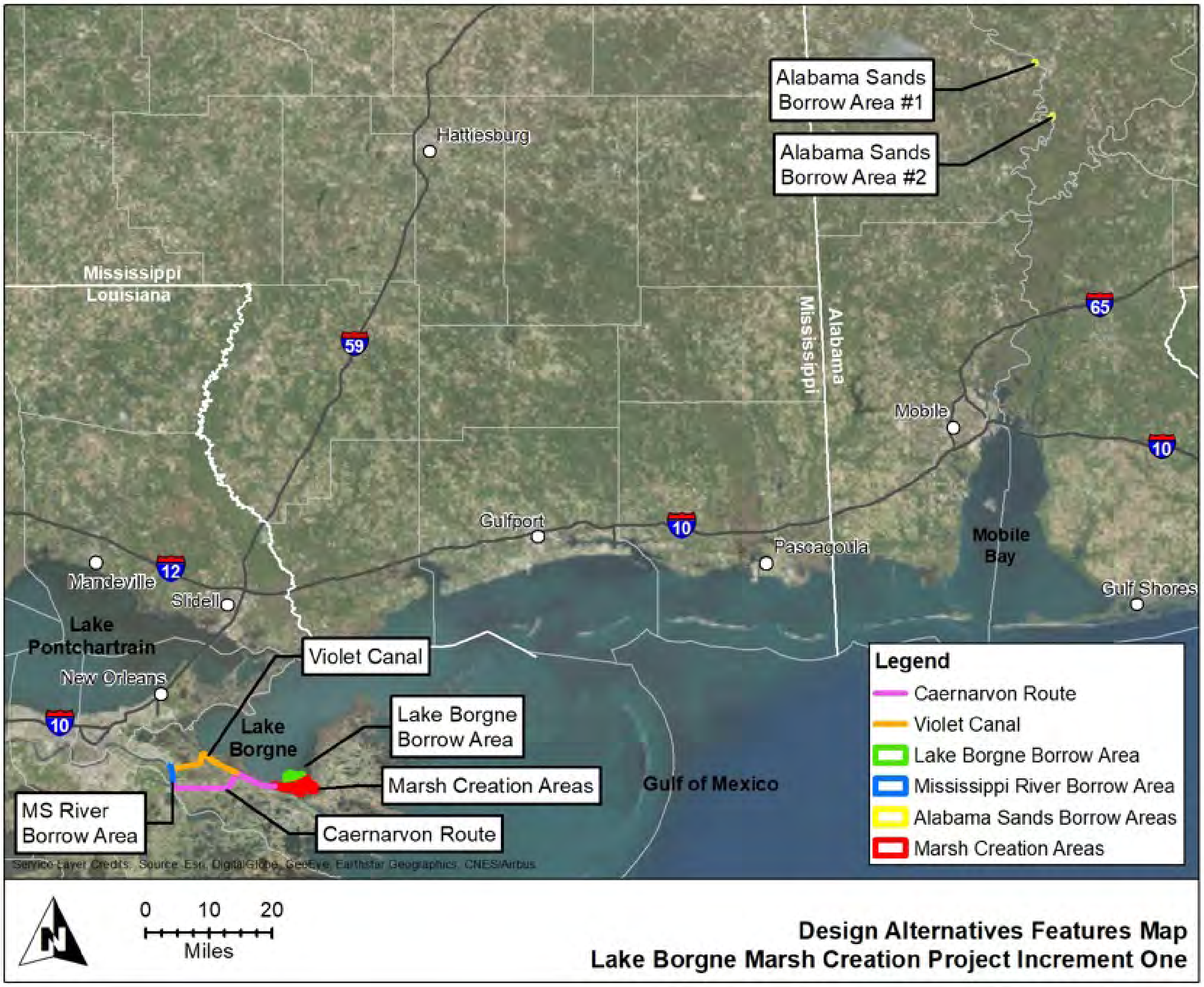

Figure 2-4. Lake Borgne Project Design Alternative Features.

- **Design Alternative LB1** creates marsh habitat limited to the original Increment One footprint (see Figure 3-3) where approximately 1,473 acres of marsh would be created. The alternative proposes to use the Lake Borgne borrow area as the source of dredge material for marsh restoration. Material would be dredged to a depth of 10 feet and transported to the MCAs through two 100-footlong pipelines from the lake side.
- **Design Alternative LB2** would expand beyond the original Increment One footprint by restoring the marsh covering the lake rim from Bayou Yscloskey to Bayou St. Malo. The footprint would require approximately 18.2 MCY for a total MCA of 2,662 acres. The alternative proposes to use the Lake Borgne borrow area as the source of dredge material for marsh restoration. Material would be dredged at a 10-foot cut and transported through two 100-foot pipelines from the lake side.
- **Design Alternative MR-C1** restores the original Increment One footprint, where approximately 1,548 acres of marsh habitat would be created. The alternative proposes to use the Mississippi River borrow area as the source of dredge material for marsh

restoration. The proposed borrow area would be the bar associated with the Lower 9 Mile Point Anchorage area (CPRA 2018b) located on the west bank of the river. The northern point of the Mississippi River borrow area is near Violet Canal, and the southern end is near Caernarvon. The borrow area would be dredged to a maximum depth of −90 feet North American Vertical Datum of 1988 (NAVD 88), yielding an estimated volume of 9.5 MCY. The Caernarvon Conveyance Corridor would be used to deliver dredge and fill material under this design alternative. The proposed 17-mile-long corridor would be a predominantly land-based route with most of the non-submerged pipe located within the flood protection area.

- **Design Alternative MR-V1** restores the original Increment One footprint, where approximately 1,548 acres of marsh habitat would be created. The alternative proposes to use the Mississippi River borrow area as the source of dredge material for marsh restoration similar to Design Alternative MR-C1. The Violet Canal Conveyance Corridor would be used to deliver dredge and fill material to the MCA under this alternative. The proposed 17-mile-long corridor would be a predominantly waterborne route located within the flood protection area.
- **Design Alternative MR-C2** would expand the MCA to an area slightly larger than the original Increment One footprint. A total of approximately 1,550 acres of marsh would be created that would include the entire Increment One footprint and the area along the Mississippi River Gulf Outlet (MRGO) shoreline and the lake rim. The alternative proposes to use the Mississippi River borrow area as the source of dredge material for marsh restoration similar to Design Alternative MR-C1. The Caernarvon Conveyance Corridor would be used to deliver dredge and fill material under this design alternative. The access route for delivery of material to the MCA would follow the same configuration as Design Alternative MR-C1.
- **Design Alternative MR-V2** would expand the MCA to an area slightly larger than the original Increment One footprint. A total of approximately 1,550 acres of marsh would be created that would include the entire Increment One footprint and the area along the MRGO shoreline and the lake rim. The alternative proposes to use the Mississippi River borrow area as the source of dredge material for marsh restoration similar to Design Alternative MR-C1. The Violet Canal Conveyance Corridor would be used to deliver dredge and fill material under this design alternative. The access route for delivery of dredge and fill material would follow the same configuration as Design Alternative MR-V1.
- **Design Alternative AS** would restore an area smaller than the original Increment One Footprint, where approximately 1,010 acres of marsh habitat would be created. The alternative proposes to use stored Tombigbee River, Alabama dredge materials from the U.S. Army Corps of Engineers (USACE) Mobile District disposal sites located between river miles 73 and 96.2 for marsh restoration. This alternative was considered because USACE has excess sand from dredging operations and is seeking a beneficial use of that material. The stored dredge material, referred to as the Alabama Sands, would provide a total of 6.8 MCY of clean quartz sand and gravel for use as fill material at the project site. Sand deposits would be recovered and barged to an offloading area near the MCA. The material would be loaded onto barges using a conveyor system from the upland disposal site over the loading areas along the Tombigbee River. Multiple loading conveyors would be required. Once loaded, a raft of barges would be towed down the

Tombigbee River, out of Mobile Bay, and over to the MCA. This would require a loading setup at the seven sites between river miles 73 and 96.2, a process that adds considerable cost to the project. Construction of Increment One would require approximately 7.0 MCY once settlement and losses are considered - more material than would be available from the Alabama Sands.

- **Design Alternative LB3** proposes to use the original Increment One footprint and include MCAs extending south to Lena Lagoon and east past Jahncke's Ditch and Bayou St. Malo. The footprint of the MCAs would increase marsh restoration in areas that are currently open water while providing marsh nourishment in areas east of Bayou St. Malo. Approximately 2,935 acres would be restored using an estimated 13.0 MCY of fill from the Lake Borgne borrow area.

The design alternatives are summarized in **Table 2-3**. Project costs were developed for the *Lake Borgne Marsh Creation Project Increment One (PO-0180) Alternatives Analysis Report* (CPRA 2018a).

Table 2-3. Lake Borgne Marsh Creation Project Design Alternatives.

	Alternative LB1	Alternative LB2	Alternative MR-C1	Alternative MR-V1	Alternative MR-C2	Alternative MR-V2	Alternative AS	Alternative LB3
Description of fill area footprint	Increment One footprint	Increment One footprint with lake rim extension	Increment One footprint	Increment One footprint	Increment One footprint expanded slightly	Increment One footprint expanded slightly	Smaller than Increment One footprint	Increment One footprint with Lena Lagoon configuration
Borrow area	Lake Borgne	Lake Borgne	Mississippi River	Mississippi River	Mississippi River	Mississippi River	Tombigbee River	Lake Borgne
Conveyance	NA	NA	Caernarvon corridor	Violet canal	Caernarvon corridor	Violet canal	Barge	NA
MCA acres	1,473	2,662	1,473	1,473	1,550	1,550	1,010	2,935
Fill volume in cubic yards	6,929,000	11,820,000	5,535,000	5,535,000	6,600,000	6,550,000	4,000,000	13,010,000
Costs	$46,286,075	$93,279,419	$92,741,224	$94,495,706	$109,703,140	$109,703,140	$118,316,291	$101,814,664
Cost/MCA acres	$31,423	$35,041	$62,961	$64,152	$70,776	$70,792	$109,181	$34,690

Design alternatives were scored and ranked based on potential impacts to cultural resources, environmental resources (e.g., T&E Species, MBTA species, and EFH), hydrodynamics, infrastructure, navigation, and other metrics (**Table 2-4**). For each impact area or resource, a score was assigned to each alternative. A value of 0 indicates that impacts to those resources are not applicable for that alternative (e.g., utilizing a borrow source in the Mississippi River will have no impact on water quality or wave climate in Lake Borgne). A value of 1 indicates the resource is not likely to be impacted. A value of 2 indicates that minor impacts are likely to occur but these impacts are expected to be temporary or can be appropriately mitigated by following standard permit conditions. A value of 3 indicates that more moderate impacts are likely to occur and the design alternative would require more extensive consultation with resource agencies and possibly adjustments to minimize impacts and receive regulatory approvals.

Table 2-4. Design Alternatives Scoring Matrix: Lake Borgne Marsh Creation Project Increment One.

Evaluation Criteria	Alternative LB1 Impact Scores	Alternative LB2 Impact Scores	Alternative MR-C1 Impact Scores	Alternative MR-V1 Impact Scores	Alternative MR-C2 Impact Scores	Alternative MR-V2 Impact Scores	Alternative AS Impact Scores	Alternative LB3* Impact Scores
Cultural Resources	2	2	2	2	2	2	2	2
T&E Species – *Gulf Sturgeon*	2	3	0	0	0	0	0	3
T&E Species – *Pallid Sturgeon*	0	0	1	1	1	1	0	0
T&E Species – *West Indian Manatee*	1	1	1	1	1	1	1	1
Colonial Nesting Birds/MBTA Species	1	1	1	1	1	1	1	1
Submerged Aquatic Vegetation	1	1	1	1	1	1	1	1
EFH	1	1	1	1	1	1	1	1
Water Quality/Dissolved Oxygen	2	2	0	0	0	0	0	2
Wave Climate	2	2	0	0	0	0	0	2
Oysters	2	2	2	2	2	2	2	2
Other Wetland Impacts	1	1	2	2	2	2	1	1
Pipelines	1	1	2	2	2	2	1	1
Existing Shoreline Protection Features (Lake Borgne)	2	2	0	0	0	0	2	2
Transportation	0	0	3	3	3	3	0	0
Flood Protection Features (Lake Borgne)	0	0	3	3	3	3	0	0
Oil and Gas Wells	2	2	0	0	0	0	0	2
UXO	3	3	0	0	0	0	2	3
Navigation	0	0	3	3	3	3	2	0
Total Score	**23**	**24**	**22**	**22**	**22**	**22**	**16**	**24**

*Preferred Alternative
MBTA – Migratory Bird Treaty Act; T&E – threatened and endangered

All of the design alternatives have relatively few impacts to most of the physical, biological, and socioeconomic environmental criteria. However, there were differences in impact for some T&E species, water quality, wave climate, other wetland impacts, pipelines, existing Lake Borgne shoreline protection, transportation, Lake Borgne flood protection features, gas wells, unexploded ordnances (UXO) and, navigation. Specifically, the alternatives using the Lake Borgne borrow sites have a greater potential for adverse impacts to Gulf sturgeon critical habitat, as described in more detail below.

2.2.3 Natural Recovery

Pursuant to the OPA regulations, the Final PDARP/PEIS considered “a natural recovery alternative in which no human intervention would be taken to directly restore injured natural resources and services to baseline” (40 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 marsh creation 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 outcome is no recovery. If recovery were to occur, it would take much longer compared to a scenario in 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 evaluation within the Final PDARP/PEIS (DWH Trustees 2016a). Based on this determination and incorporating that analysis by reference, the LA TIG did not further evaluate natural recovery as a viable alternative under OPA for the Spanish Pass Project and the Lake Borgne Project.

2.2.4 Conclusion

The LA TIG has completed its screening of design alternatives under an initial application of the OPA restoration evaluation criteria to develop a reasonable range of design alternatives for these two projects.

Spanish Pass Project

The scoring matrix demonstrated that all of the Spanish Pass project design alternatives would have the same environmental impacts; but two of the design alternatives, 6A-Scenario 1 and 6B-Scenario 2, had substantially lower unit costs than the others. The LA TIG thus determined that these two design alternatives should be carried forward for further analysis. These design alternatives would meet the LA TIG’s goals and objectives for the project, have a high likelihood of success, would produce benefits through the creation of wetland habitat, would not impact public health and safety, and are cost-effective. These two design alternatives generate 1,794 and 1,661 acres of marsh, respectively, at costs per unit acre of $52,896 and $66,078, respectively. Design Alternative 6A-Scenario 1 is the LA TIG’s Preferred Alternative.

Lake Borgne Project

For the Lake Borgne project, any of the design alternatives would contribute to the goal of restoring wetlands, coastal, and nearshore habitats, as part of a larger restoration portfolio that restores for the ecosystem-scale injury resulting from the DWH oil spill. However, the LA TIG has determined that two design alternatives, LB3 and LB2, should be carried forward for analysis because they are the most cost-effective alternatives. These two design alternatives generate 2,935 and 2,662 acres of marsh at costs per acre of $34,690 and $35,041, respectively. These design alternatives would meet the LA TIG’s goals and objectives for the project, have a high likelihood of success, would produce benefits through the creation of wetland habitat, would not impact public health and safety, and are cost-effective. Design Alternative LB3 is the LA TIG's Preferred Alternative.

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Section 3 Reasonable Range of Alternatives

According to the NRDA regulations under OPA, trustees are responsible for identifying a reasonable range of restoration project alternatives (15 CFR § 990.53(a)(2)) that can be evaluated according to the OPA evaluation standards (15 CFR § 990.54). As described in Section 2.2, the design alternatives meet the OPA NRDA criteria. The LA TIG conducted a thorough and comprehensive evaluation to uniformly and objectively assess these alternatives (CPRA 2018a). The LA TIG applied each of the OPA NRDA criteria to the reasonable range of alternatives in this section to provide a summary explanation of the types of questions and analysis raised under each of the OPA NRDA criteria and a narrative summary of each evaluation with respect to those criteria.

3.1 Design Alternatives: Spanish Pass Project

A reasonable range of alternatives was carried forward for restoration at Spanish Pass after evaluating each design alternative under an initial application of the OPA criteria during the screening process. This reasonable range of design alternatives, comprising Design Alternatives 6A-Scenario 1 and 6B-Scenario 2, is described in greater detail and evaluated under the OPA criteria below.

Six borrow areas have been identified that could be used to provide the fill volumes needed for project completion. These borrow areas include the riverine areas identified as B2, DDDD, Hopper Dredge Disposal Area (HDDA), and BBBB and two offshore borrow areas identified as Grand Liard East and Grand Liard West (**Figure 3-1**).

3.1.1 Design Alternative 6A-Scenario 1

Design Alternative 6A-Scenario 1 (**Figure 3-1**) was identified as the Preferred Alternative and would restore ridge and marsh habitat by raising soil elevations to a level that would improve resilience to sea level rise and subsidence. Raised landforms, such as coastal ridges typical of natural tidal waterways, offer moderating effects on storm surges and serve to reduce wave-induced erosion of tidal marshes. Under Design Alternative 6A-Scenario 1, approximately 139 acres of ridge and 1,794 acres of marsh habitat would be created or nourished using an estimated 12.2 MCY of fill from the borrow areas. Further details of the design components are presented below.

3.1.1.1 Borrow Areas

Approximately 12.2 MCY of material would be needed to construct the proposed project. The final selection of borrow areas would be complete following additional geotechnical investigations to confirm sand content in each of the Mississippi River borrow source. However, as currently envisioned only the Mississippi River borrow areas would be used for Alternative 6A-Scenario 1. The DDDD borrow area consists of approximately 12.7M cy of borrow material consisting of 25-80% sand; the BBBB area contains approximately 42.8M cy of borrow material consisting of 25-80% sand; and B2 contains approximately 16M cy of borrow material consisting of 55-85% sand. The HDDA, which is used as a sediment disposal area for local maintenance dredging operations, is periodically dredged to maintain capacity for sediment disposal. The HDDA area contains approximately 8M cy of borrow material, consisting of 45-85% sand. HDDA has supplied over 39M cy of sediment since 1998 (Baird, 2019).

Figure 3-1. Spanish Pass Design Alternative 6A-Scenario 1 with Borrow Areas.

3.1.1.2 Conveyance Corridors

Corridors containing sediment conveyance pipelines would be established to transport sediment from the borrow areas to the MCAs and ridge creation areas. Conveyance corridors from the four Mississippi River borrow areas would converge on the south side of the entrance to Grand Pass. The corridor would continue to the confluence of Grand Pass and Tiger Pass, then along Halliburton Road, and then under Tide Water Road to the start of the eastern proposed fill areas.

Within the project area, land bridges would be created to enable access to the MCAs. Elevation of the land bridges would be at least 2 feet above the mean high water level to allow construction access during all tidal cycles and minimize sediment runoff. The exact location and dimensions of the land bridges would be determined during construction.

3.1.1.3 Marsh Creation Areas

Approximately 1,794 acres of marsh area would be restored within the proposed project area. The salinity and marsh type vary across the creation area from intermediate brackish marsh to saline marsh habitat. Vegetation is predominantly salt-tolerant grasses. Existing water depths and topography in the marsh creation areas vary between -5.0’ and +3.0’ NAVD88. Depending on the borrow source and placement location, constructed marsh elevations may vary between a maximum of +3.3’ and a minimum of +1.6’ NAVD88. Any ridge feature will be constructed to an +5.0’ elevation. NAVD88. Due to conveyance distances from the borrow areas to the MCAs, the project would use fill material from multiple borrow areas to minimize construction costs. The current design assumes that all of the borrow would come from the Mississippi River, and that this material will have a low silt content. If further geotechnical investigation reveals a higher than anticipated silt content, the design may need to be revised to provide for higher initial target elevations and/or the use of containment dikes.

3.1.1.4 Ridge Creation Areas

Approximately 139 acres of ridge area would be restored within the proposed project area. A typical cross section for the ridge creation areas is shown on **Figure 3-2**. The ridge for the Preferred Alternative is located on the northern edge of the MCAs. Ridge dimensions include a crown width of 80 feet, a target elevation of +5.0 feet NAVD 88, 1:20 side slopes that taper into existing marsh on the north side, and constructed marsh platforms on the south side.

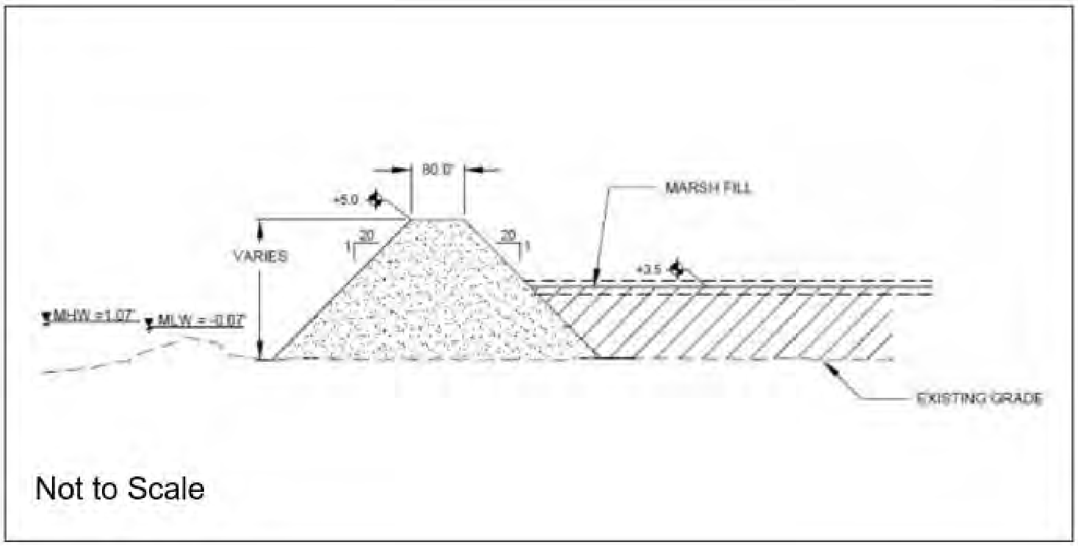


Figure 3-2. Spanish Pass Project Typical Cross Section.

3.1.2 Design Alternative 6B-Scenario 2

Design Alternative 6B-Scenario 2 is a modified version of Design Alternative 6A-Scenario 1. This scenario assumes that Mississippi River borrow areas have too high a silt content to construct an uncontained MCA platform. This would require the contractor to construct containment dikes around a number of MCAs, as summarized in Section 2.2.1. With the need for containment, this scenario also assumes that borrow for the westernmost MCAs will be obtained from the Grand Liard borrow area. As in Alternative 6A-Scenario 1, ridge dimensions include a crown width of 80 feet and a target elevation of +5.0 feet NAVD 88. These ridges would be constructed with high sand content from borrow area B2.

This alternative would also require conveyance corridors from the Grand Liard borrow areas to the westernmost MCAs. These conveyance corridors would converge east of the Grand Liard

East area then proceed through Sandy Pass Point and Bayou Jacques to the western proposed fill areas.

3.2 Comparison of Design Alternatives: Spanish Pass Project

The LA TIG evaluated the Preferred and Non-preferred Alternatives under the OPA restoration evaluation criteria (15 CFR § 990.54(a)) as described below:

Cost-effectiveness: Alternative 6A would cost approximately $94,896,000 to implement and is significantly less expensive than Alternative 6B, which would cost approximately $109,757,000 to implement. Alternative 6A would create an additional 133 acres of marsh relative to Alternative 6B and the unit cost for Alternative 6A ($52,896/acre) is lower than for Alternative 6B ($66,078/acre). Alternative 6A is therefore more cost-effective.

Goals and objectives: Consistent with the Final PDARP/PEIS, the Preferred and Non-preferred Alternatives would meet the LA TIG's goals and objectives for the project because both alternatives would restore marsh habitats and provide the greatest benefits in the coastal restoration area.

Likelihood of success: The Preferred and Non-preferred Alternatives are both 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 (i.e., Coastal Wetlands Planning, Protection and Restoration Act [CWPPRA] projects).

Prevent future injury and avoid collateral injury: The Preferred and Non-preferred Alternatives would maintain open water areas, thereby providing measures to avoid collateral injury to fisheries' resources. None of the borrow or fill areas for the Preferred or Non-preferred Alternatives overlap with known critical habitat.

Benefits to natural resources: The Preferred and Non-preferred Alternatives would each create more than 1,600 acres of ridge and marsh habitats, restoring the habitats that were most significantly impacted by the DWH oil spill. However, the Preferred Alternative would create more usable habitat initially and over the life of the project.

Health and safety: The LA TIG does not anticipate impacts to public health and safety from implementing any of the design alternatives. During construction, all laws and regulations pertaining to worker safety would be followed.

3.3 OPA Analysis Conclusion: Spanish Pass Project

The LA TIG selects Alternative 6A as the Preferred Alternative for the Barataria Basin Ridge and Marsh Creation Project Spanish Pass Increment. This Alternative would create 1,794 acres of marsh and 139 acres of ridge, for a total of 1,933 acres of wetlands, nearshore and coastal habitat restoration. During the development of design alternatives, subareas were screened to eliminate those with significant impacts to natural resources, oyster leases, and infrastructure such as pipelines. Furthermore, each of the design alternatives spans the same east-west gradient in salinity, vegetation, and geotechnical characteristics across the project area. Therefore, all of the proposed design alternatives have a similar likelihood of success, avoid collateral injury, provide similar benefits to natural resources, and have minimal health and safety impacts. Alternative 6A was selected because it is the most cost-effective alternative on a cost per acre basis.

A draft Monitoring and Adaptive Management Plan for the Spanish Pass project is included in **Appendix F1**.

3.4 Lake Borgne Project Design Alternatives

A reasonable range of alternatives was carried forward for restoration at Lake Borgne after evaluating each design alternative under an initial application of the OPA criteria during the screening process. This reasonable range of design alternatives, comprising Design Alternatives LB2 and LB3, is described in greater detail and evaluated under the OPA criteria below.

3.4.1 Design Alternative LB3

Design Alternative LB3 (**Figure 3-3**) was selected as the Preferred Alternative. Design Alternative LB3 would restore marshes along the southern shoreline of Lake Borgne by raising soil elevations to a level that would improve coastal resilience to sea level rise and subsidence. This area of marsh currently has a high potential for erosion due to exposure to wind-driven waves, boat traffic, and deteriorating shoreline protection features. The footprint of Design Alternative LB3 would increase marsh restoration in areas that are currently open water, while providing marsh nourishment in areas along the shoreline west of Bayou St. Malo. This alternative was selected based on its ability to provide protection to both the MRGO shoreline and the Lake Borgne rim, and its similar cost per acre relative to the non-preferred alternative.

The Preferred Alternative would include the original Increment One footprint (see **Figure 3-3**) and include MCAs extending south to Lena Lagoon and east past Jahncke's Ditch and Bayou St. Malo. The original Increment One footprint (similar to alternative LB1) was under the construction budget of $120 million, so additional alternatives were considered to maximize the creation of marsh habitat. The final LB3 alternative excludes an area of private property in the middle of the MCA, northwest of Lena Lagoon. Approximately 2,935 acres would be restored using approximately 13.0 MCY of fill from the Lake Borgne borrow area. Further details of the Preferred Alternative design components are presented below.

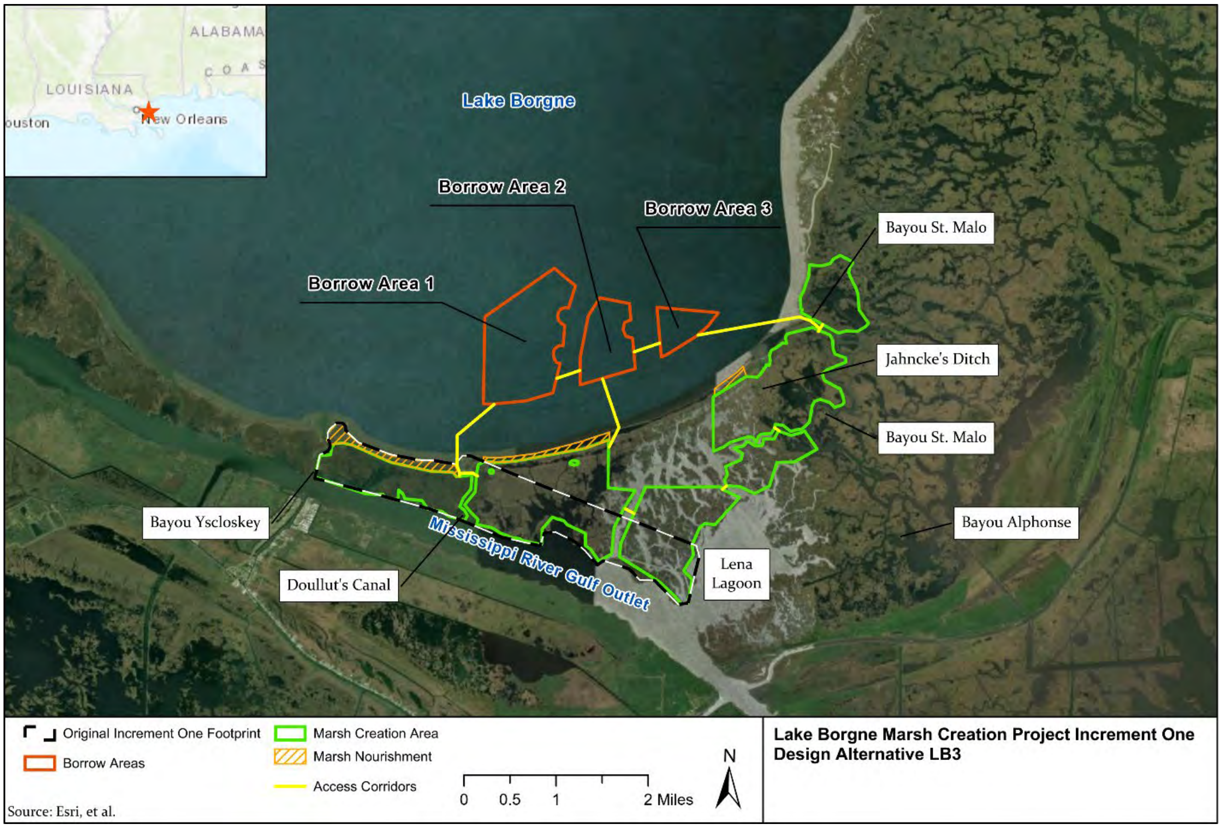


Figure 3-3. Lake Borgne Marsh Creation Project – Design Alternative LB3.

3.4.1.1 Borrow Area

The Preferred Alternative would use the Lake Borgne borrow area, which is approximately 2,630 acres in size and can provide up to 42 MCY of material as a source of dredge fill material. This project will utilize material from three distinct areas within the Lake Borgne borrow source, with areas of approximately 628, 275, and 140 acres, as shown in **Figure 3-3**. In addition to the cost savings, this borrow area was chosen to limit impacts to existing oyster leases, avoid previously abandoned oil and gas wells, and avoid areas of high magnetic anomaly density that could be indicative of UXOs. Further investigation would be conducted prior to construction to perform UXO analysis to further identify any potential avoidance areas within the borrow area. Due to the large borrow area, it should be possible to avoid any infrastructure or other hazardous areas and still have access to adequate fill volumes for the MCAs.

The borrow area is located in a broad region designated as critical habitat for Gulf sturgeon under the Endangered Species Act, and the depths in Lake Borgne are suitable for Gulf sturgeon (Ross et al 2009). However, previous studies indicate that Gulf sturgeon prefer foraging habitats with substrate composed of a higher percentage of sand (typically 80 percent or greater) than what is found in Lake Borgne (Ross et al., 2009). Soil classification studies conducted by

USACE designated Lake Borgne soils as predominantly silty, with only 2 of 109 samples collected having a sand content close to 75 percent (CPRA, 2018a).

3.4.1.2 Marsh Creation Areas

The Preferred Alternative would consist of the original Increment One footprint plus approximately 1,460 additional acres for a total footprint of 2,935 acres of MCA (**Figure 3-3**). This MCA footprint was chosen to restore some of the most degraded areas of marsh that exist along the southeastern shore of Lake Borgne, and restore marsh areas that are currently open water to provide greater benefits to the injured nearshore and shoreline habitats. The Preferred Alternative would also provide marsh nourishment along the lake rim to Bayou St. Malo.

3.4.1.3 Access Routes

Cost and impact avoidance were the driving factors for selection of the Lake Borgne access routes. The Preferred Alternative would use three, 100-foot-wide access routes (**Figure 3-3**). Access route alignments were placed to avoid all historical, cultural, and oyster resources. Potential use of Doullut's Canal as an interior access point would bring the pipeline closer to the center of the MCAs and minimize impacts to the rock breakwater and existing marsh.

3.4.2 Design Alternative LB2

Design Alternative LB2 is a modified version of Design Alternative LB3. Most of the project components for Design Alternative LB2 are the same as those for Design Alternative LB3; however, the MCA would expand beyond the original Increment One footprint by restoring the marsh covering the lake rim from Bayou Yscloskey to Bayou St. Malo. The footprint would require approximately 18.2 MCY for a total MCA of 2,662 acres.

3.5 Comparison of Design Alternatives: Lake Borgne Project

The LA TIG evaluated the Preferred and Non-preferred Alternatives under the OPA restoration evaluation criteria (15 CFR § 990.54(a)) as described below:

Cost-effectiveness: The Preferred Alternative would cost approximately $100,814,664 ($34,690/acre) to implement. Similar projects within this region have historically had unit costs between $40,000 to $60,000 per acre, based on approximately 500-acre projects.

Goals and objectives: Consistent with the Final PDARP/PEIS, the Preferred and Non-preferred Alternatives would meet the LA TIG's goals and objectives for the project because both alternatives would restore marsh habitats and provide benefits in the coastal restoration area.

Likelihood of success: The Preferred and Non-preferred 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 (i.e., CWPPRA projects).

Prevent future injury and avoid collateral injury: The Preferred and Non-preferred Alternatives would maintain open water areas, thereby providing measures to avoid collateral injury to fisheries' resources. Both alternatives would require dredging of the Lake Borgne borrow areas, creating the potential for collateral impacts to Gulf sturgeon designated critical habitat. The magnitude of these collateral impacts is uncertain, in part due to uncertainties related to sand content and dissolved oxygen levels in the borrow area. However, because available data indicates that the sand content in the borrow area is generally below 75%, the Lake Borgne borrow areas are not likely to be preferred foraging areas for the Gulf sturgeon. Additionally, sonic transmission studies have found that Gulf sturgeon are only located in open water between October and March (Ross et al., 2009). The potential for collateral injury to Gulf sturgeon could be further reduced by targeting dredging activities between April and September, as recommended for other recent projects in Lake Borgne (NOAA, 2011). Because both alternatives would utilize the same borrow sources, their potential for collateral injury is expected to be the same.

Benefits to natural resources: The Preferred and Non-preferred Alternatives would provide a similar level of benefits to natural resources through marsh creation. However, Alternative LB3 would create 2,935 acres of marsh habitat, whereas Alternative LB2 would create 2,662 acres.

Health and safety: The LA TIG does not anticipate impacts to public health and safety from implementing any of the design alternatives. The project area is uninhabited, remote, and accessible only by boat. During construction, all laws and regulations pertaining to worker safety would be followed.

3.6 OPA Analysis Conclusion: Lake Borgne Project

The LA TIG identifies Alternative LB3 as the Preferred Alternative for the Lake Borgne Project. This Alternative would restore 2,935 acres of marsh habitat along an area of marsh that currently has a high potential for erosion due to exposure to wind-driven waves, boat traffic, and deteriorating shoreline protection features, During the development of design alternatives, consideration was given to impacts to natural resources, oyster leases, and infrastructure such as pipelines. The Preferred and Non-preferred design alternatives have a similar likelihood of success, provide similar benefits to natural resources, and have minimal expected health and safety impacts.

Design Alternatives LB2 and LB3 each use dredge and fill source material from nearby Lake Borgne, providing substantial cost savings relative to other borrow sources. Because they use the same borrow source, both alternatives have the same potential to create collateral impacts to designated critical habitat for Gulf sturgeon in Lake Borgne. Design Alternatives LB2 and LB3 have similar costs on a cost/acre basis, but Alternative LB3 creates more useable habitat in the short term and the long term. As a result, Design Alternative LB3 is the Preferred Alternative.

A Monitoring and Adaptive Management Plan for the Lake Borgne project is included in **Appendix F2.**

Section 4 Affected Environment and Environmental Consequences

4.1 Introduction

This section includes a description of the affected environment and an analysis of the environmental consequences of the reasonable range of design alternatives for the Spanish Pass and Lake Borgne projects. The affected environment of the two project areas may vary in certain resource areas due to the difference in locations (see **Figure 1-1**). The affected environment for both design alternatives for each project would be the same, as the location of the marsh creation and borrow areas for each are the same. For each project, where the environmental consequences would be the same for both design alternatives, the analysis is combined.

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 temporary or long-term. Impacts were assessed in accordance with the guidelines in the Final PDARP/PEIS (**Appendix A**).

The analysis of beneficial impacts focuses on the duration (short- or long-term) without attempting to specify the intensity of the benefit as is consistent with that used in the Final PDARP/PEIS. The results of any completed, protected resources consultations are included in the Administrative Record.

4.2 Minimally Affected Resources Common to All Alternatives

To avoid redundant or unnecessary information, alternatives addressed in this Phase 2 RP/EA #1.2 were reviewed to determine whether some resources either would not be affected or would have minimal (minor or less than minor), short-term impacts that are common to all alternatives. Minimal impacts common to different resource areas are described below, and then are not described or analyzed further in this chapter. Those resources, along with the rationale for grouping the analysis of impacts to the resources in this section, are as follows.

4.2.1 Physical Environment

4.2.1.1 Air Quality

EPA developed the National Ambient Air Quality Standards (NAAQS) that list six atmospheric pollutants considered harmful to public health in accordance with the Clean Air Act of 1970 (as amended). 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 these areas, EPA requires states to develop and/or revise a state implementation plan to ensure the standards will be attained.

A qualitative analysis was completed for both the Barataria Basin Ridge and Marsh Creation Spanish Pass Increment project and the Lake Borgne Marsh Creation Increment One project regarding the Clean Air Act Amendments of 1990. EPA has determined that Plaquemines Parish (Spanish Pass) is currently below NAAQS for all pollutants; St. Bernard Parish is currently below NAAQS for all pollutants except sulfur dioxide. St. Bernard Parish has been in nonattainment for sulfur dioxide since 2013. Because there will be federal funding/action for the project, general conformity would apply.

Impacts to air quality would be minor and limited to construction activities. An increase in vegetation could potentially provide a long-term benefit to air quality for the area. Under all action alternatives, short-term, minor, adverse air quality impacts may occur during construction due to the dust and fumes from equipment and earthwork activities. Additional effects may also arise from an increase in boat traffic required to deliver equipment, materials, and construction workers to the work sites. These localized temporary impacts would not exceed the EPA's *de minimis* criteria for general conformity determination under the Clean Air Act (40 CFR § 93.153). An increase in vegetation could potentially provide a long-term benefit to air quality for the area. Overall, the action alternatives would result in minimal to negligible effects on air quality. No change would occur under no action.

4.2.1.2 Noise

The Final PDARP/PEIS (Chapter 6, DWH Trustees 2016a) states the primary sources of terrestrial noise in the coastal environment are transportation- and construction-related activities, which is consistent with the sources identified in this Phase 2 RP/EA #1.2. The primary sources of ambient (background) noise in the project areas are recreational boating vessels and natural sounds such as wind and wildlife. The level of noise in the project areas vary, depending on the season, time of day, number and types of noise sources, and distance from the noise source.

Noise impacts associated with all action alternatives would be mainly from construction activities. The dominant noise sources from construction elements are expected to be earth-moving and dirt-hauling activities. General construction noise impacts would include short-term, minor, adverse effects. Because the closest human activity to Spanish Pass and Lake Borgne is over 0.5 and 0.25 mile away, respectively, noise impacts from the site to resident populations would not occur. Minor noise impacts to wildlife, such as colonial waterbirds, could occur. However, construction would be conducted during the nonbreeding season to limit noise impacts to a variety of bird species that have been document for the project. Overall, construction noise impacts to the area are expected to be minimal and of short duration. Therefore, impacts from noise would be short-term, minor to negligible, adverse impacts limited to construction activities.

4.2.2 Biological Environment

4.2.2.1 Protected Species

A list of federally threatened and endangered species and other protected species with the potential to occur within the project areas was developed based on the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation resource list for the areas in which the alternatives would occur and the Plaquemines and St. Bernard Parishes lists (USFWS 2019a) and information from the National Marine Fisheries Service (NMFS).

Protected species with potential to occur in both project areas include West Indian manatee (*Trichechus manatus*), loggerhead sea turtle (*Caretta caretta*), bottlenose dolphin (*Tursiops truncatus*), and Gulf sturgeon (*Acipenser oxyrinchus desotoi*). Species with potential to occur only in the Spanish Pass project area include piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), hawkbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and pallid sturgeon (*Scaphirhynchus albus*). No additional protected species would be expected to occur in the Lake Borgne project area.

In accordance with the ESA, the LA TIG is requesting concurrence from NMFS and USFWS with their determination of "may affect, not likely to adversely affect" for the following threatened and endangered species that may occur in the Spanish Pass project area: West Indian manatee, pallid sturgeon, Kemp's ridley sea turtle, loggerhead sea turtle, hawksbill sea turtle, leatherback sea turtle. For any in-water work, the alternatives would implement measures from the National Marine Fisheries Service's (NMFS's) *Sea Turtle and Smalltooth Sawfish Construction Conditions* (2006), *Measures for Reducing Entrapment Risk to Protected Species* (2012), and *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008) and USACE's *Standard Manatee Conditions for In-water Work* (2011). These measures would minimize the potential for impacts to listed sea turtles, pallid sturgeon, West Indian manatees, and bottlenose dolphins[3]. Additionally, construction best management practices (BMPs) and other avoidance and mitigation measures as required by state and federal regulatory agencies would minimize water quality impacts that could affect the aquatic habitat. There is no identified critical habitat in the Spanish Pass project or borrow areas.

The LA TIG has made determination of "no effect" for the following threatened and endangered species that may occur in the Spanish Pass project area: Gulf sturgeon, red knot, piping plover. The piping plover and red knot may occur in portions of Plaquemines Parish, but the suitable beach and dune-foraging habitats required by these species are not present in the proposed restoration project area or the potential borrow areas. The Spanish Pass project area is outside the current known range for the Gulf sturgeon (USFWS 2019b). Therefore, the proposed project is not expected to affect these species. There is no designated critical habitat

[3] Manatees are protected under both the ESA and the MMPA. Bottlenose dolphins are protected only under the MMPA.

for any species within the Spanish Pass project area. Therefore, there would be no impacts to critical habitat.

In accordance with the ESA, the LA TIG is requesting concurrence from NMFS and USFWS with their determination of “may affect, not likely to adversely affect” for the two threatened and endangered species that may occur in the Lake Borgne project area: West Indian manatee and loggerhead sea turtle. Any in-water work would follow the same BMPs as described for the Spanish Pass project to minimize impacts to protected species, including the aforementioned listed species and bottlenose dolphin.

4.2.3 Socioeconomic Environment

4.2.3.1 Socioeconomics and Environmental Justice

The intent of an environmental justice evaluation under Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations, is to identify communities and groups that meet environmental justice criteria and suggest strategies to reduce potential adverse impacts of projects on affected groups. The purpose of EO 12898 is to identify and address the disproportionate placement of adverse environmental, economic, social, or health impacts from federal actions and policies on minority and/or low-income communities. This order requires lead agencies to identify and address, as appropriate, disproportionately high and adverse environmental effects on minority and low-income populations from projects or programs that are proposed, funded, or licensed by federal agencies. The Spanish Pass and the Lake Borgne project design alternatives are anticipated to benefit natural resources over the long term. Implementation is anticipated to result in short-term increases in the demand for employment. Construction activities involving construction equipment and commuting workers would increase traffic and may lead to road closures in localized areas. However, these impacts would be minor and short-term in nature. None of the design alternatives for these projects would create a disproportionately high and adverse effect on minority or low-income populations. Improvements in marsh habitat could provide benefits to commercial and recreation fishing industries through benefits to fish populations.

4.2.3.2 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; historical or prehistoric artifacts or objects; rock inscriptions; human burial sites; or earthworks, such as battlefield entrenchments, prehistoric canals, or mounds.

As stated in the Final PDARP/PEIS, all projects implemented under subsequent restoration plans and tiered NEPA analyses consistent with the Final PDARP/PEIS would secure all necessary state and federal permits, authorizations, consultations, or other regulatory processes and ensure the project is in accordance with all applicable laws and regulations concerning the protection of cultural and historical resources (DWH Trustees 2016a). If any culturally or historically important resources were identified during project preparations or predevelopment surveys, such areas would be avoided during construction. A complete review of all alternatives under Section 106 of the National Historic Preservation Act is ongoing and would be completed prior to implementation of any proposed activities. Alternatives would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historical resources.

Spanish Pass project

A phase I cultural resources survey was conducted for the Spanish Pass project area (CPRA 2018a). One archaeological site, a late 19th to early 20th century fishing camp, was identified within 1 mile of the project area. Further investigation is recommended to determine its eligibility for inclusion in the National Register of Historic Places (NRHP). No other sites or structures listed in, or eligible for listing in, the NRHP were identified during background research or fieldwork investigation. The phase I cultural resources survey concluded that no further cultural resources work is recommended in the project area.

Lake Borgne project

A preliminary cultural resource evaluation was conducted on the borrow area and MCAs in February 2018 for the Lake Borgne project area (CPRA 2018b). The evaluation reviewed previously recorded cultural resources in the potential project area. Two submerged vessels are located in the vicinity of the project area: a 37-foot cabin cruiser—Queen Mary II—and the Good Brothers fishing vessel. In addition, 11 archaeological sites and 1 historical structure were identified as being within, or partially within, the potential project area. Two of the 12 sites were recommended as ineligible for listing in the NRHP, and one site, located along the northeastern portion of the potential project area, is considered eligible for listing in the NRHP. However, the NRHP eligibility status of the remaining nine sites has yet to be assessed. Furthermore, one NRHP-listed property, Fort Proctor, is located within a 0.5-mile buffer of the borrow area.

A phase I cultural resources survey was conducted for the MCA components of the project area in December 2018 (R. Christopher Goodwin & Associates, Inc. 2018) to identify archaeological sites or other historical resources. The survey included background research, review of historical maps and aerial photographs, and fieldwork, including excavations in areas with a high-probability of containing cultural resources. Three sites (16SB74, 16SB75, and 16SB205) were identified as containing intact shell middens or ceramics that warrant either avoidance or additional testing to determine if the site contains important deposits. For the Lake Borgne project design alternatives, project buffers of sufficient width have been established at the three sites identified during the phase I cultural resources survey. No fill would be placed within these buffers to protect the potential cultural resources at the three identified sites. Consultations with the Louisiana State Historic Preservation Office based on the findings of the phase I cultural resources survey would be conducted during the design stages of the project.

With mitigation measures in place, none of the proposed design alternatives are expected to affect known cultural resources. However, if project conditions change and impacts to these sites could not be avoided, further investigations would be conducted and consultations would be initiated.

Section 106 consultation would be completed prior to implementation of the proposed projects, and they would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural resources.

4.2.3.3 Land and Marine Management

The Coastal Zone Management Act is a federal act that encourages states to develop coastal management programs for preserving statewide coastal resources. Under this act, once a state develops a federally approved coastal management program, “federal consistency” requires that any federal actions affecting coastal land or water resources (the coastal zone) must be consistent with the state’s program. In Louisiana, the LDNR Office of Coastal Management oversees the state’s Coastal Zone Management (CZM) Program. Both the Spanish Pass and Lake Borgne projects are located within the Louisiana Coastal Zone established by the State and Local Coastal Resources Management Act of 1978 and modified in 2012.

The Plaquemines Parish CZM Program divided the parish into 22 environmental management units (EMUs) (Plaquemines Parish 2013). The proposed Spanish Pass project area is located within the Grand Liard, Bastian Bay, and Barataria Barrier Shorelines EMUs. Goals for managing the coastal resources in these units include protecting the natural environment; coordinating with state and federal agencies to achieve desired land use and wetland conservation, restoration, and enhancement objectives; and encouraging restoration of eroded wetlands where practicable. (Plaquemines Parish 2013).

The St. Bernard Parish CZM Program divided the parish into 15 EMUs (St. Bernard Parish 2012). Lake Borgne is included as its own EMU (#14), and the marshlands to its south and southwest are within the Bienvenue-Proctor Point Marsh EMU (#1) and the Biloxi Marsh EMU (#8). Goals for managing the coastal resources in these units include reducing shoreline erosion, maintaining shoreline integrity of Lake Borgne, and nourishing and restoring marshes (St. Bernard Parish 2012). In addition, the parish’s 2018 coastal strategy document includes Lake Borgne marsh creation as a large-scale, high priority, coastal restoration project (St. Bernard Parish 2018).

Both the projects’ preferred design alternatives would support the goals outlined in their respective parish’s CZM Programs and would result in long-term, beneficial impacts to land and marine management due to their aim of restoring ridge and/or marsh habitats. Requests for consistency certification were sent to the state on April 22, 2019 and December 19, 2018 for the Spanish Pass and Lake Borgne projects, respectively.

4.2.3.4 Tourism and Recreational Use

The Spanish Pass project area, including its surroundings, are popular destinations for boating, birdwatching, fishing, camping and other recreational activities. There are no public hunting sites within this project area; however, waterfowl hunting is permitted in the area to those granted access to private lands. The project area is accessible by boat; there are no roads or railroads within the project area (Plaquemines Parish 2013).

Lake Borgne and its surroundings are a popular destination for boating, birdwatching, kayaking, fishing, hunting, trapping, and other recreational activities. Portions of the Lake Borgne project area are located in the Biloxi Wildlife Management Area, which is accessible only by boat. In addition, segments of the project area are leased to recreational waterfowl hunters.

Both projects' design alternatives would serve to enhance recreational opportunities and experiences. In the short term, the design alternatives may result in minor, adverse impacts to tourism and recreation use if construction activities were to discourage visitors. However, the alternatives would result in long-term, beneficial impacts to tourism and recreational use due to increased wildlife populations and wildlife viewing opportunities.

4.2.3.5 Aesthetics and Visual Resources

The primary visual features in the Spanish Pass project area include marshes, shallow open waters, man-made canals and associated spoil banks, and the West Bank Hurricane Protection Levee bordering it to the north (**Figure 4-1** and **4-2**).

Figure 4-1. Spanish Pass Marshes.

Figure 4-2. Spanish Pass Open Water and Marshes.

The primary visual features in the Lake Borgne Marsh Creation Increment One project area include the open waters of Lake Borgne and marshes and shoreline bordering it to the southwest, including rock breakwaters (**Figures 4-3** and **4-4**).

Figure 4-3. Lake Borgne Marshes.

Figure 4-4. Lake Borgne Rock Breakwater.

All design alternatives would result in long-term, beneficial impacts to aesthetics and visual resources as they would serve to restore ridges and marshes, which in turn would increase wildlife habitat, thereby enhancing the natural aesthetics and visual resources of the areas.

4.2.3.6 Public Health and Safety

All design alternatives would involve restoring ridges and/or marshes within both project areas. Ridges and marshes act as a buffer to reduce the effects of wave action, saltwater intrusion, storm surge, and tidal current. Therefore, all design alternatives would result in long-term, beneficial effects to public health and safety through the restoration and nourishment of existing ridges and/or marshes. Both project design alternatives would comply with EO 13045, Protection of Children from Environmental Health Risks and Safety Risks, and do not represent disproportionately high and adverse environmental health or safety risks to children in the United States. All relevant health and safety protocols would be followed to protect workers during construction and monitoring activities. Implementation of these projects would not create other health and safety concerns.

4.2.3.7 Marine Transportation

Navigation channels used by recreational and commercial vessels reaching the Spanish Pass project site include the Mississippi River, Scofield Bayou, Empire to Gulf Waterway, Grand Bayou, Bayou Chaland, Bayou Grand Liard, and the Gulf of Mexico.

Navigational channels used by recreational and commercial vessels reaching the Lake Borgne project site include Bayou Bienvenue, Bayou Yscloskey, Bayou St. Malo, Bayou La Loutre, MRGO, and the Gulf Intracoastal Waterway.

Construction activities would be conducted to avoid any unreasonable interference with navigation of marine transportation. The design alternatives for the Spanish Pass and Lake Borgne projects would not result in impacts to marine transportation because the proposed projects would not unreasonably interfere with or create obstructions to navigation on the surrounding waterways.

4.3 Resources Analyzed in Detail: Spanish Pass Project

The reasonable range of design alternatives for the Spanish Pass project is analyzed in detail below for those resources that could differ between the design alternatives and have potential for moderate to more severe impacts, along with potential mitigation (e.g. BMPs, permit conditions). Alternative 6A is the preferred design alternative for the Spanish Pass project.

4.3.1 Physical Environment

4.3.1.1 Geology and Substrates

4.3.1.1.1 Affected Environment

The project area is a coastal marsh on the southern shore of the current channel of the Mississippi River, in Plaquemines Parish, Louisiana. Coastal marshes, such as those present in the project area, act as a buffer to reduce the effects of wave action, saltwater intrusion, storm surge, and tidal currents on associated estuaries and wetlands. The geography of coastal marshes is highly dynamic and greatly affected by weather conditions.

The geologic features within the project area are characterized by Holocene-era gray to black clay of very high organic content, including some peat (Louisiana Geological Survey 1984). Surface soils in the project area have been classified by USDA Natural Resources Conservation Service (NRCS) as primarily Clovelly muck with 0 to 0.2 percent slopes and very frequently flooded and Balize and Larose soils with 0 to 1 percent slopes (USDA NRCS 2019). These soils are very poorly drained and classified as having negligible runoff, which is typical of continuously flooded tidal areas and coastal marshes. Additionally, narrow strips of Bellpass muck appear along marsh edges. Bellpass muck is similar to Clovelly muck but will not form slopes. The remainder of the project area contains dredged mucks and clays with 0 to 1 percent slopes. The borrow areas for the Spanish Pass project range from fluvial sand and silt deposits in the Mississippi River borrow areas to soft silts and clays in the offshore borrow areas.

4.3.1.1.2 Environmental Consequences

Design Alternative 6A

Design Alternative 6A involves placing fill material within the ridge creation areas and MCAs. Fill material would be deposited over the existing Clovelly muck and Balize and Larose soils, resulting in similar post-project soil textures of clay and sand. After fill placement, marsh vegetation would be allowed to recolonize naturally. Marsh vegetation would help stabilize soils and reduce soil loss due to erosion in the long term. The additional ridge creation would limit wave exposure to the MCAs to provide protection of the newly placed soils. Therefore, this revegetation would have a long-term, beneficial impact on geology and substrates.

Short-term, minor, adverse impacts to terrestrial substrates, such as localized soil disturbances or compaction, may result from use of heavy equipment during site preparation and restoration implementation. These impacts likely would be localized to small areas and offset by the beneficial restoration activities. Staging areas for construction equipment and materials have not yet been finalized. The establishment of construction BMPs would help to minimize impacts of construction, staging areas, and site preparation on substrates. BMPs could include the implementation of erosion controls, development of and adherence to a stormwater management plan, and ongoing construction monitoring. Avoiding sand fill placement before or during severe weather would minimize erosion during construction. Excavation of the borrow sites would create localized soil disturbances, which would be expected to refill with river sediment relatively quickly for the Mississippi River borrow sites, and more slowly for the offshore borrow sites. These excavations would result in localized short term, minor to moderate adverse impacts to terrestrial substrates. Overall, the Preferred Alternative would result in short-term, minor, adverse impacts and long-term, beneficial effects on geology and substrates.

Design Alternative 6B

Under the Design Alternative 6B, impacts to geology and substrates would be similar to those under Design alternative 6A.

No Action Alternative

Under the No Action Alternative, none of the proposed alterations to the project area's geology or substrates would occur. In the short term, geology and substrate conditions would remain the same as described above. However, due to local subsidence and sea level rise, long-term, adverse impacts would occur from inundation and erosion. Therefore, under the No Action Alternative, impacts to substrates would be adverse and long-term.

4.3.1.2 Hydrology and Water Quality

4.3.1.2.1 Affected Environment

Spanish Pass is in the Mississippi River Delta Basin (Mississippi River Basin), which is approximately 521,000 acres in size. The majority of this basin is open water (420,000 acres) or coastal marsh (61,650 acres) (CWPPRA 2019). Freshwater and sediment inputs in this area are abundant. (CWPPRA 2019). Based on the *Final 2018 Louisiana Water Quality Integrated Report* (LDEQ 2018), Spanish Pass (subsegment LA070401_00) is listed as fully supporting the designated use for primary contact recreation, secondary contact recreation, and fish and wildlife propagation. However, it is listed as not supporting the designated use for oyster propagation. Fecal coliform is the suspected cause of impairment to oyster propagation due to marine/boating sanitary on-vessel discharges (LDEQ 2018). Therefore, there are current water quality impairments at the Spanish Pass project and borrow areas.

Spanish Pass is located within 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 wave action (FEMA Map Numbers

2201390920C 1990 and 2201391125C 1992). Base flood elevations of the 1-percent-annual-chance flood have been determined.

4.3.1.2.2 Environmental Consequences

Design Alternative 6A

Design Alternative 6A involves fill placement to create a marsh platform and reestablish historical ridges, which would alter the project area's surface conditions. Fill material placement would result in impacts to hydrology and water quality while impacts in the surrounding area should be minimal. Therefore, Design Alternative 6A would result in long-term, minor to moderate impacts to hydrology in the project area.

Due to the restoration of linear, historical ridges, most of the dredge material should be contained within the MCA, which would limit runoff. The proposed fill substrates would have a high sand content, making the area highly permeable. Additionally, the natural establishment of vegetation would serve to stabilize soils and reduce soil loss. Therefore, the impacts to local water quality are expected to be short-term, minor, and adverse.

Short-term, minor, adverse impacts to water quality in and near Spanish Pass are expected during implementation of restoration and construction activities. Localized erosion and sediment transport are expected during fill material placement. Localized increases in turbidity are also expected in the borrow areas during excavation. 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. The construction BMPs, in addition to other avoidance and mitigation measures as required by state and federal regulatory agencies, would minimize water quality and hydrology impacts. Establishment of and adherence to BMPs during construction and restoration could minimize water quality impacts.

Design Alternative 6A would result in minor to moderate adverse impacts to hydrology within Spanish Pass and adjacent waters. Restoration of the coastal ridge could result in short- and long-term, beneficial impacts to water current patterns by creating conditions that more closely resemble natural, historical current patterns. Some existing circulation patterns would remain since the proposed ridge is not contiguous and channels would remain between restoration cells. Salinity gradients would likely decrease as the proposed design elevations were selected to establish a brackish salinity regime in the MCA (CPRA 2019).

Other aspects of hydrology may be unimpacted or negligibly impacted. Two-dimensional hydrodynamic modeling of project impacts conducted during design predicted that the project would have insignificant impacts on 100-year storm surge elevations, water quality, and channel flow velocities in and around the project area (CPRA 2019).

Overall, the Alternative 6A would result in long-term, beneficial impacts to water quality with short-term, minor to moderate, adverse effects on hydrology and water quality in the project and borrow areas due to construction. However, these changes are consistent with the goals and objectives of the restoration efforts and would support the development of marsh habitat.

Design Alternative 6B

Under Design Alternative 6B, impacts to hydrology and water quality would be similar to those under Design Alternative 6A. However, there would be an additional ridge on the south side of MCAs to provide containment in case the borrow sources lack adequate sand content. This would limit runoff from the dredge areas even more. Therefore, there would be more long-term, beneficial impacts to hydrology and water quality under Design Alternative 6B compared to Design Alternative 6A.

No Action Alternative

Under the No Action Alternative, the proposed placement of sand fill material would not occur, and the hydrology of Spanish Pass would remain unchanged. The No Action Alternative would result in no short-term adverse impacts compared to the action alternatives because no restoration and construction activities with potential for water quality impacts (fill placement, breakwater installation, and use of equipment) would occur. However, under the No Action Alternative, local subsidence and sea level rise would continue, which would result in long-term, adverse impacts to both hydrology and water quality within the project area and in the adjacent waters. Under the No Action Alternative, there would be long-term adverse impacts to water current patterns, normal water fluctuations, and salinity gradients due to loss of marsh habitat.

4.3.2 Biological Environment

4.3.2.1 Habitats

4.3.2.1.1 Affected Environment

The Spanish Pass project area is characterized by low-elevation emergent marshes interspersed with ridges and navigation channels. The emergent marshes are generally near sea level, with maximum ground elevations rarely exceeding 2 feet above sea level. These emergent marshes are classified as intermediate marshes in the eastern portion of the project area near Venice, Louisiana, and as saline marshes in the western portions of the project area toward Mitchell Pond (Sasser et al. 2014). Intermediate marshes are oligohaline marshes with diverse plant communities and an irregular tidal regime and variable salinity conditions (Holcomb et al. 2015). Dominant vegetation in intermediate marshes typically consists of narrow-leaved, persistent species that can tolerate salinity fluctuations (Lester et al. 2005). 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 (Holcomb et al. 2015).

Both intermediate and saline marshes provide important nesting, brood-rearing, and foraging habitat for various bird species, including migratory birds and colonial nesting birds. 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 (Lester et al. 2005; Holcomb et al. 2015).

Substrates within the MCAs and offshore borrow areas (i.e., Grand Liard) may provide suitable habitat for oysters (*Crassostrea virginica*) and other mollusks. The MCAs do not contain public oyster seed grounds but are bordered by several oyster lease areas. The Grand Liard conveyance corridor passes through existing oyster lease areas (LDWF 2013). The riverine borrow areas are not likely to provide suitable oyster habitat.

Open water habitats also occur within the project area. Water depths of these systems are generally less than 3 feet, with maximum depths of around 10 feet in some channels (CPRA 2018b). Three of the proposed borrow areas are located in the mainstem Mississippi River (B-2, DDDD, and BBBB), and the Grand Liard borrow areas (East and West) are located in open offshore waters near the project site. According to NOAA nautical charts, approximate water depths in the proposed borrow areas and conveyance corridors are 35 to 60 feet in B2, 15 to 35 feet in DDDD, 5 to 25 feet in BBBB, and 15 to 25 feet in Grand Liard East and West (NOAA 2018).

4.3.2.1.2 Environmental Consequences

Design Alternative 6A

Design Alternative 6A would involve restoration of ridge and marsh habitats through placement of dredged fill material. Marsh restoration would increase the quantity and quality of emergent marsh habitat in the project area. Some existing marsh habitat would be converted into elevated ridge habitat. Creation of the ridge would increase the availability of forested upland habitat in the project area. The coastal ridge would also function to mitigate storm surges and reduce wave-induced erosion in nearby emergent marshes, thereby reducing long-term susceptibility to subsidence and eustatic sea level rise. Design Alternative 6A would therefore provide short- and long-term, beneficial impacts to ridge and marsh habitats.

There would also be short-term, minor, adverse impacts to existing marsh habitats associated with construction activities during fill material placement. The use of boats, construction machinery, and other heavy equipment within and around marshes may result in short-term, minor, adverse impacts to marsh habitats due to localized soil and sediment disturbances and contamination from possible vehicle fuel and fluid leaks. Short-term, minor, adverse impacts may also result during site preparation and materials staging. Some of the tidal areas that are currently shallow tidal waters would be filled with dredged material to create elevated ridge and marsh habitat. Filling the tidal habitats would constitute a short-term, minor to moderate, adverse impact to those affected tidal habitats.

Dredging would have adverse impacts on habitats within and adjacent to the borrow areas. Short-term, minor, adverse impacts would occur in the aquatic habitats above the benthic zone as there would be temporary local disturbances from dredging equipment and increased vehicle traffic along the access routes. Short-term, moderate, adverse impacts would occur in benthic habitats that are actively dredged or in which conveyance pipelines are installed. BMPs would be implemented to minimize impacts during construction.

Post-construction monitoring protocols for the Preferred Alternative would be developed during the permitting phase. Compliance with permit conditions and implementation of monitoring programs would likely reduce the adverse effects of the Preferred Alternative on terrestrial and aquatic habitats.

Alternative 6A would have short- and long-term, beneficial impacts on ridge and marsh habitats. There would be short-term, minor, adverse impacts associated with construction in and around the restoration areas during fill placement. There would be long-term, minor to moderate, adverse impacts to the aquatic habitats that are filled with dredged material. In the borrow areas, there would be short-term, minor, adverse impacts on aquatic habitats above the bottom due to vehicle traffic and construction disturbances. There would be short-term, moderate, adverse impacts on benthic habitats in the borrow area due to conveyance pipeline construction and dredging.

Design Alternative 6B

Under Design Alternative 6B, beneficial impacts to habitats would be similar to those under Design Alternative 6A, including the short- and long-term impacts to marsh and ridge habitats. The total restoration area would be the same for the two alternatives (1,875 acres), but Alternative 6B would involve creation of 28 fewer acres of emergent marsh habitat and 28 more acres of ridge habitat. However, because Alternative 6B would require placement of conveyance pipeline along two alignments (compared to one pipeline for the Alternative 6A), there would be greater adverse impacts associated with construction of Alternative 6B. Therefore, compared to the Alternative 6A, there would be similar beneficial impacts to marsh and ridge habitats but greater short-term adverse impacts associated with construction disturbances.

No Action Alternative

Under the No Action Alternative, the adverse impacts to existing marsh and aquatic habitats associated with dredging and fill placement would not occur. However, without restoration of emergent marsh habitat and the reconstruction of historical ridge habitats, existing habitats in the project area would be more susceptible to continued subsidence, erosion, and sea level rise compared to the action alternatives. Therefore, there would be no long-term, beneficial impacts to ridge and marsh habitats under the No Action Alternative.

4.3.2.2 Wildlife Species

4.3.2.2.1 Affected Environment

Many wildlife species, including numerous birds, mammals, reptiles, and amphibians, would be expected to use marsh, open water, and ridge habitats located within the Barataria Basin Ridge and Marsh Creation Spanish Pass Increment project area. Mammals expected to occur within the project area include armadillos, dolphins, bats, coyotes, foxes, mice, nutria, opossum, otters, rabbits, and raccoons. Reptiles expected to occur within the project area include alligators, lizards, snakes, and turtles (iNaturalist 2019a). Both intermediate and saline marshes within the project area provide important nesting, brood-rearing, and foraging habitat for various bird species, including migratory birds and colonial nesting birds. 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 (Lester et al. 2005; Holcomb et al. 2015).

A variety of bird species currently use the project area for foraging, roosting, and breeding. A total of 255 species of birds have been documented within or directly adjacent to the project area (**Figure 4-5**) (The Cornell Lab of Ornithology 2019). These species include flycatchers, gulls, herons, kites, hawks, pelicans, night herons, egrets, sandpipers, sparrows, swallows, terns, shorebirds, waterfowl, and woodpeckers. Many of the birds observed are those that would be expected to use the edge habitats between the emergent marshes and the surrounding uplands. Of the 255 bird species observed in the Barataria Basin Ridge and Marsh Creation Spanish Pass Increment project area, 35 are listed as Birds of Conservation Concern by USFWS for Plaquemines Parish. These species represent the highest conservation priorities of USFWS beyond those currently designated as threatened or endangered (USFWS 2019a, 2008).

Figure 4-5. Spanish Pass Project Bird Observation Locations.

4.3.2.2.2 Environmental Consequences

Design Alternative 6A

Design Alternative 6A could result in temporary displacement of birds during construction. These birds would need to find other areas to forage, loaf, and breed during this time. However, these impacts would be short-term, and suitable habitats are available nearby. Following the restoration, birds of the area should return quickly. 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.

Design Alternative 6A would result in long-term, beneficial impacts to bird species that are in the project area and the State of Louisiana. These benefits would result from the enhancement of ridge and marsh habitats and the establishment of 1,794 acres of new marsh habitat that is important for the feeding, nesting, and roosting needs of migratory and nonmigratory bird species. Design Alternative 6A would also result in approximately 139 acres of new ridge creation. The enhanced and newly created habitats would also create beneficial habitat for mammals, reptiles, and amphibians that rely on ridge and marsh habitats for all or part of their life cycle.

Design Alternative 6B

Under Design Alternative 6B, impacts to wildlife would be similar to Design Alternative 6A. Birds would be temporarily displaced during construction and would need to find other areas to forage, loaf, and breed during this time. These impacts would be short-term. Following the restoration, birds of the area should return quickly. 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.

Design Alternative 6B, as with Design Alternative 6A, would result in long-term, beneficial effects to bird species in the project area. These benefits would result from the enhancement of ridge and marsh habitats and the establishment of 1,661 acres of new marsh habitat (approximately 130 acres less than Design Alternative 6A) that is important for the feeding, nesting, and roosting needs of migratory and nonmigratory bird species. The enhanced and newly created habitats would also create beneficial habitat for mammals, reptiles, and amphibians that rely on ridge and marsh habitats for all or part of their life cycle. Design Alternative 6B would result in additional ridge habitat for a total of approximately 271 acres.

No Action Alternative

Under the No Action Alternative, there would be no direct impacts to wildlife. There would be long-term, adverse impacts to wildlife populations as ridge and marsh habitats continue to degrade within the project area to the point where fewer birds and other wildlife would use the marshes.

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

4.3.2.3.1 Affected Environment

The water bodies and emergent marshes within and adjacent to the project area provide essential nursery and foraging habitats supportive of a variety of aquatic fauna, including economically important estuarine and saltwater species. Historically, shrimp have generated the largest share of income followed by oysters, menhaden (*Brevoortia patronus*), blue crab (*Callinectes sapidus*), and striped mullet (*Mugil cephalus*) (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998). Additionally, the marshes and open waters of the project area provide habitat for species that support recreational fishing, which is important culturally and economically.

The Gulf of Mexico Fishery Management Council (GMFMC), in cooperation with NMFS, has delineated EFH for federally managed species in coastal Louisiana (GMFMC 2005). The Spanish Pass project is located in Eco-Region 4 (NOAA 2015), and within the project area EFH has been designated for 19 species, including shrimp, fish, and sharks (see **Tables G-1** through **G-4** located in **Appendix G**).

4.3.2.3.2 Environmental Consequences

Design Alternative 6A

Marsh restoration would increase the quantity and quality of emergent marsh habitat in the project area. Some existing marsh habitat would be converted into approximately 139 acres of ridge habitat, which would permanently impact marsh habitats. Impacts to these areas may affect aquatic fauna, fisheries, and EFH and would alter present habitats. Therefore, Design Alternative 6A would have short- and long-term, minor, adverse impacts associated with placement of fill in the MCAs and long-term, moderate, adverse impacts associated with ridge creation. Disturbed and displaced aquatic fauna in these areas would likely find refuge in nearby suitable habitats. Conversely, for those species that depend on emergent marsh habitats, Design Alternative 6A would increase the quantity and quality of emergent marsh habitat. The Barataria Basin Ridge and Marsh Creation Spanish Pass Increment project would result in the restoration of 1,794 acres of optimal marsh habitat and therefore provide long-term benefits.

Dredging activities within the four designated borrow areas may have several impacts on EFH, including disruption of prey sources, noise disturbances, and impacts to spawning and feeding habitats due to turbidity and siltation. Impacts from dredging and transport of material are expected to be minimized because of the short distances from the borrow areas to the fill areas. The access routes have been established to avoid oyster sites and confine the transport of dredge material. Therefore, impacts resulting from dredging the borrow source areas would cause short-term, minor, adverse impacts to aquatic fauna, fisheries, and EFH.

Potential impacts to estuarine and aquatic fauna, managed fish species, and EFH would be considered and avoided or minimized to the extent practicable during design and construction. When impacts cannot be avoided, BMPs would be implemented with the intent of minimizing the potential magnitude and duration of impacts to aquatic fauna, managed fisheries, and EFH. BMPs during construction would help to avoid and minimize impacts when protected and managed species are expected to be present or when most vulnerable. They would also likely include standard erosion and sediment control measures to protect water quality and aquatic habitats from impacts resulting from construction and sediment runoff. EFH consultation guidance documents on the NMFS webpage accessible at the URL via the following link: (https://www.fisheries.noaa.gov/) provide additional best practices to avoid or limit project impacts to EFH. Specific BMPs for the protection of EFH would be identified and selected based on project elements and chosen construction methods during the final engineering design.

Design Alternative 6A would have short- and long-term, minor to moderate, adverse effects on marine and estuarine aquatic fauna, EFH, crustaceans, mollusks, and other aquatic organisms due to construction and habitat conversion. However, there would be long-term, beneficial impacts to most species and EFH due to the improvement, enhancement, and creation of marsh habitats. The loss of any EFH habitat would be offset by higher quality and higher quantities of EFH following marsh enhancement.

Design Alternative 6B

Design Alternative 6B would also increase the quantity (1,661 acres) and quality of emergent marsh habitat in the project area, and impacts would be similar to those from Design Alternative 6A. The main difference is that Design Alternative 6B includes differing amounts of marsh and ridge habitats. Impacts to these areas may affect aquatic fauna, fisheries, and EFH and would alter present habitats. Therefore, Design Alternative 6B would have short-and long-term, minor, adverse impacts associated with placement of fill in the MCAs and long-term, moderate, adverse impacts associated with ridge creation. As with Design Alternative

6A, Design Alternative 6B would benefit fish species dependent on emergent marsh habitats by increasing the quantity (1,661 acres) and quality of emergent marsh habitat.

Design Alternative 6B dredging activities would be similar to those of Design Alternative 6A. Therefore, impacts resulting from dredging the borrow source areas would cause short-term, minor, adverse impacts to aquatic fauna, fisheries, and EFH.

As with Design Alternative 6A, potential impacts to estuarine and 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, BMPs would be implemented with the intent of minimizing the potential magnitude and duration of impacts to aquatic fauna, managed fisheries, and EFH. BMPs during construction would help to avoid and minimize impacts when protected and managed species are expected to be present or when most vulnerable. Specific BMPs for the protection of EFH would be identified and selected based on project elements and chosen construction methods during the final engineering design. If NMFS determines that effects of the proposed action require mitigation to EFH, a mitigation plan would be developed. The mitigation plan would identify appropriate mitigation that would be designed and implemented as appropriate.

Design Alternative 6B would have short- and long-term, minor to moderate, adverse impacts on marine and estuarine aquatic fauna, EFH, crustaceans, mollusks, and other aquatic organisms due to construction and habitat conversion. However, there would be long-term, beneficial impacts to most species and EFH due to the improvement, enhancement, and creation of marsh habitats. The loss of any EFH habitat would be offset by higher quality and higher quantities of EFH following marsh enhancement.

No Action Alternative

Under the No Action Alternative, no additional adverse or beneficial impacts to aquatic fauna, EFH, or managed fisheries would be expected in the short term. The conditions at the project site would remain largely the same. Because of continued degradation of aquatic habitats from erosive forces, subsidence, and sea level rise, there would be long-term, minor to moderate, adverse impacts to aquatic fauna, EFH, and managed fisheries compared to the action alternatives.

4.3.3 Socioeconomic Environment

4.3.3.1 Fisheries and Aquaculture

4.3.3.1.1 Affected Environment

The project area is open to recreational and commercial fishing. Fishermen in the project area primarily harvest oysters, finfish, crabs, and shrimp (Plaquemines Parish 2013). Existing oyster leases are present within the project area.

4.3.3.2.2 Environmental Consequences

Design Alternative 6A

Design Alternative 6A could result in short-term, minor, adverse impacts to fisheries and aquaculture during construction. However, such impacts would be minimized through BMPs, and all stipulations and procedures outlined in the applicable permits would be followed accordingly. Long term, beneficial impacts to fisheries and aquaculture could occur due to improvements in marsh habitat and fisheries populations.

Design Alternative 6B

Impacts to fisheries and aquaculture due to Design Alternative 6B would be similar to those under Design Alternative 6A.

No Action Alternative

Under the No Action Alternative, no changes to the existing ridges and marshes would occur. Thus, the No Action Alternative would result in no short-term impacts to recreational or commercial fisheries and aquaculture. However, potential adverse impacts to fisheries and aquaculture may occur over the long term due to the loss of suitable marsh habitat for many commercially important species.

4.4 Resources Analyzed in Detail: Lake Borgne Project

The reasonable range of design alternatives for the Lake Borgne project is analyzed in detail below for those resources that could differ between the design alternatives and have potential for moderate to more severe impacts, along with potential mitigation (e.g. BMPs, permit conditions). Alternative LB3 is the preferred design alternative for the Lake Borgne project.

4.4.1 Physical Environment

4.4.1.1 Geology and Substrates

4.4.1.1.1 Affected Environment

The Lake Borgne project area is a coastal marsh on the southern shore of Lake Borgne, a lagoon of the Gulf of Mexico, in St. Bernard Parish, Louisiana. This area is within the Lower Pontchartrain subbasin, which was formed from two Mississippi River deltaic processes: the St. Bernard Delta Lobe and the modern delta known as Plaquemines/Balize. Sedimentation in this area has declined since the Mississippi River naturally abandoned the St. Bernard delta lobe approximately 2,000 years ago. Levee construction along the Mississippi River halted freshwater input into the Lower Pontchartrain subbasin. Construction of the MRGO canal, oil canals, and natural processes, such as sea-level rise and subsidence, have resulted in coastal erosion and saltwater intrusion within the basin.

Coastal marshes, such as those present in the project area, act as a buffer to reduce the effects of wave action, saltwater intrusion, storm surge, and tidal currents on associated estuaries and wetlands. The geography of coastal lagoons, such as Lake Borgne, is highly dynamic and greatly affected by weather conditions.

Lake Borgne’s geology is characterized by Holocene-era gray to black clay of high organic content, including some peat (Louisiana Geological Survey 1984). Surface soils in the project area have been classified by USDA NRCS as primarily Clovelly muck with 0 to 0.2 percent slopes, very frequently flooded (USDA NRCS 2018). These soils are very poorly drained and classified as having negligible runoff, which is typical of continuously flooded tidal areas and coastal marshes. Additionally, narrow strips of Fausse clay appear along the lake rim. Fausse clay is a firm clay and is otherwise similar in characteristics to Clovelly muck. Recent geotechnical investigations down to 45 feet below ground surface primarily encountered soft lean clays and fat clays with organic materials, with alternating layers of loose silty or clayey sands, which is consistent with the USDA NRCS data (CPRA 2018a). The geology of the borrow area is predominantly silt, with some areas containing up to 60% sand content (CPRA 2018a).

4.4.1.1.2 Environmental Consequences

Design Alternative LB3

Design Alternative LB3 involves placing fill material within the MCA to create elevated marshes. Dredged material would be deposited over the existing Clovelly muck and Fausse clay, resulting in predominantly clay and sand surface soils. After fill placement, marsh vegetation in the MCAs would be allowed to recolonize naturally. Marsh vegetation would help stabilize soils and reduce soil loss due to erosion in the long term. Therefore, this revegetation would have a long-term, beneficial impact on substrates.

Short-term, minor, adverse impacts to terrestrial substrates, such as localized soil disturbances or compaction, may result from use of heavy equipment during site preparation and restoration implementation. These impacts likely would be localized to small areas and offset by the beneficial restoration activities. Staging areas for construction equipment and materials have not yet been finalized. The establishment of construction BMPs would help to minimize impacts of construction, staging areas, and site preparation on substrates. BMPs could include the implementation of erosion controls, development of and adherence to a stormwater management plan, and ongoing construction monitoring. Avoiding sand fill placement before or during severe weather would minimize erosion during construction. Short term, minor to moderate, adverse impacts to subaqueous substrates would also be expected in the borrow areas. These impacts would be localized to the excavation sites and would be expected to gradually fill in through time due to slumping and redistribution of sediment within Lake Borgne. Overall, Design Alternative LB3 would result in minor, short- and long-term, beneficial effects on terrestrial substrates and short term, minor to moderate adverse impacts to subaqueous substrates.

Design Alternative LB2

Under Design Alternative LB2, impacts to geology and substrates would be similar to those under Design Alternative LB3.

No Action Alternative

Under the No Action Alternative, none of the proposed alterations to the project area’s geology or substrates would occur. In the short term, geology and substrate conditions would remain the same as described above. However, due to local subsidence and sea level rise, long-term, adverse impacts would occur due to inundation and erosion. Therefore, under the No Action Alternative, impacts to substrates would be adverse and major.

4.4.1.2 Hydrology and Water Quality

4.4.1.2.1 Affected Environment

Lake Borgne is in the Pontchartrain Basin, spanning across Orleans, St. Bernard, and St. Tammany Parishes in Louisiana and Hancock County in Mississippi. The entire Pontchartrain Basin is approximately 1,700,000 acres, with 483,390 acres of wetlands (CWPPRA 2018).

Freshwater inputs into the basin are heavily impeded by the Mississippi River levees (CWPPRA 2018). Previous water quality inventory reports have listed suspected sources of water quality problems as home sewage systems, agriculture (particularly pasturelands), silviculture, urban development, urban stormwater runoff, industry, and sand and gravel mining (Louisiana Comprehensive Wildlife Conservation Strategy 2005).

Based on the *Final 2018 Louisiana Water Quality Integrated Report* (LDEQ 2018), Lake Borgne (subsegment LA0402001_00) is listed as fully supporting the designated use for primary contact recreation, secondary contact recreation, fish and wildlife propagation, and oyster propagation. Therefore, there are no current water quality impairments at Lake Borgne.

The project area within Lake Borgne is located within FEMA-designated Flood Zones V and VE, which are subject to inundation by the 1-percent-annual-chance flood event, with additional hazards due to storm-induced velocity wave action (FEMA Map Numbers 22087C0 - 575D, 550D, 800D, and 825D 2017). Base flood elevations of the 1-percent-annual-chance flood have been determined.

4.4.1.2.2 Environmental Consequences

Design Alternative LB3

Design Alternative LB3 involves fill placement to reestablish the lake rim and intertidal marsh habitat and to construct containment dikes; all would alter the project area’s surface conditions. The placement of fill material would result in similar impacts to those described for Spanish Pass.

Due to the installation of containment dikes, most of the dredge material should be contained within the MCAs, which would limit runoff. The natural establishment of vegetation would serve to stabilize soils and reduce soil loss. Therefore, impacts to local water quality from surface soil erosion are comparable to Spanish Pass.

Impacts associated with construction would be similar to those described for Spanish Pass, which included a short-term, minor, adverse impact to water quality. Effects to suspended particulates and turbidity, water current patterns, normal water fluctuations, and salinity gradients would be similar to Spanish Pass as previously described. However, because of the proximity of the borrow and marsh creation areas at Lake Borgne, overall water quality impacts are expected to be more localized for Lake Borgne than for Spanish Pass.

Overall, Design Alternative LB3 would result in long-term, beneficial impacts to water quality with short-term, minor to moderate, adverse impacts on hydrology and water quality due to construction. However, these changes are consistent with the goals and objectives of the restoration efforts and would support the development of wetland habitat.

Design Alternative LB2

Under Design Alternative LB2, impacts to hydrology and water quality would be similar to those under Design Alternative LB3.

No Action Alternative

Under the No Action Alternative, the proposed placement of fill material would not occur, and the hydrology of the lake would remain unchanged in the short term. The No Action

Alternative would result in fewer short-term, minor, adverse impacts compared to the action alternatives because no restoration and construction activities would occur. However, local subsidence and sea level rise would continue, which would result in long-term, major, adverse impacts to both hydrology and water quality within Lake Borgne and in the adjacent waters in the long term. Under the No Action Alternative, there would be long-term, major, adverse impacts to water current patterns, normal water fluctuations, and salinity gradients.

4.4.2 Biological Environment

4.4.2.1 Protected Species

4.4.2.1.1 Affected Environment

The Lake Borgne project area falls within designated critical habitat for the Gulf sturgeon. Dredging would have adverse impacts on areas designated as critical habitat for Gulf sturgeon under the ESA; however, actual impacts to Gulf sturgeon depend on the substrate properties in the borrow areas, and the timing of dredging, as summarized below.

4.4.2.1.2 Environmental Consequences

Gulf sturgeon prefer to forage in sediments with high sand content (Fox et al. 2002; Ross et al. 2009). A surface sediment evaluation of the borrow area at 241 locations was conducted to determine composition and potential suitability for Gulf sturgeon (CPRA 2018b). The substrate in the borrow area is predominantly silty clay with shell fragments, and none of the 241 borrow area substrate samples exceeded 75 percent sand, which meets the USFWS recommendation of avoiding sediment with sand content greater than 75 percent (CPRA 2018a). This indicates that the proposed borrow area does not contain preferred foraging habitat for the Gulf sturgeon (CPRA 2018b). However, Gulf sturgeon may still be present in the area and may be using parts of the action area for foraging despite the lower quality habitat due to low sand contents. Accordingly, dredging of the Lake Borgne borrow areas could potentially affect Gulf Sturgeon.

The LA TIG currently is coordinating with USFWS and NMFS to seek concurrence on their ESA determinations. For Lake Borgne, the LA TIG will request a formal consultation from NMFS to address adverse effects from dredging in designated critical habitat. Any terms and conditions will be incorporated into the final design. All required consultations would be completed prior to alternative implementation.

4.4.2.2 Habitats

4.4.2.2.1 Affected Environment

The Lake Borgne project area is characterized by low-elevation, emergent saltwater marshes interspersed with channels and tidal areas. A rock breakwater is located along the lakeward perimeter of the marsh. The project area contains no other development or infrastructure.

The emergent marshes in the project area are classified as saline marshes. Dominant vegetation in the project area is smooth cordgrass (*Spartina alterniflora*) (CPRA and U.S. Geological Survey 2018). Other species present include salt-tolerant grasses such as perennial saltmarsh aster (*Symphyotrichum tenuifolium*), annual saltmarsh aster (*Symphyotrichum divaricatum*), saltgrass (*Distichlis spicata*), and wiregrass (*Spartina patens*).

The channels and tidal waters within the emergent marshes range from shallows to deeper lagoons (up to around 18 feet deep), and Doullut's Canal in the western part of the marsh is up to 32 feet deep (CPRA 2018c). Maximum depths in Lake Borgne and the borrow area are around 10 feet, with depths in the borrow area between 7 and 9 feet (NOAA 2018; CPRA 2018a). The borrow area lake bed contains oyster habitat but does not contain oyster seed grounds (CPRA 2018a).

4.4.2.2.2 Environmental Consequences

Design Alternative LB3

Design Alternative LB3 would involve raising marsh elevations through dredged fill material placement and containment dikes. The marsh restoration would increase the quantity and quality of emergent marsh habitat while also reducing habitat susceptibility to subsidence and sea level rise.

There would be short-term, minor, adverse impacts to marsh habitats associated with construction activities during fill material placement. Impacts associated with construction, fill placement, site preparation and materials staging, and filling aquatic habitats in the MCA with dredged material are similar to those described for Spanish Pass.

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 above the lake bottom as there would be temporary local disturbances from dredging equipment, including vehicle traffic along the access routes. Short-term, major, adverse impacts would occur in lake bottom habitats that are actively dredged. No extensive submerged aquatic vegetation beds have been identified within the project area to date other than Eurasian watermilfoil (*Myriophyllum spicatum*), which is an invasive species (CPRA 2018c). If native SAV beds are identified during further design and construction phases, BMPs would be implemented to minimize impacts during construction. Post-construction monitoring protocols would be developed as discussed for Spanish Pass.

Design Alternative LB3 would have short- and long-term, beneficial impacts on emergent marsh habitats. There would be short-term, minor, adverse impacts associated with construction in and around the restoration area during fill placement. There would be long-term, minor to moderate, adverse impacts to the aquatic habitats that are filled with dredged material. In the borrow area, there would be short-term, minor, adverse impacts on aquatic habitats above the lake bottom due to vehicle traffic, construction disturbances, and dredging.

Design Alternative LB2

Under Design Alternative LB2, beneficial impacts to habitats would be less than those under Design Alternative LB3, including the short- and long-term impacts to marsh habitats. There would be fewer adverse impacts associated with construction of Design Alternative LB2 and less habitat created. Therefore, compared to Design Alternative LB3, there would be fewer beneficial impacts to marsh and ridge habitats but fewer short-term, adverse impacts associated with construction.

No Action Alternative

Under the No Action Alternative, there would be no short-term adverse impacts to marsh and aquatic habitats associated with fill placement and construction. There would also be no short-term, adverse impacts to lake bottom habitats in the borrow area because dredging would not occur. However, without restoration, the existing marshes would be more vulnerable to continued subsidence, erosion, and sea level rise compared to Design Alternatives LB2 or LB3, and benefits from implementation of those Alternatives would not occur.

4.4.2.3 Wildlife Species

4.4.2.3.1 Affected Environment

Many wildlife species, including mammals, reptiles, amphibians, and numerous bird species such as gulls, herons, egrets and blackbirds, would be expected to use marsh, open water, and ridge habitats located within the Lake Borgne project area. Marshes provide foraging, roosting, and, breeding habitats for many of these species. Mammals expected to occur within the project area would be similar to those mentioned previously for the Spanish Pass project. Reptiles expected to occur within the project area include alligators, anoles, snakes, and turtles (iNaturalist 2019b). Both intermediate and saline marshes within the project area provide important nesting, brood-rearing, and foraging habitat for various bird species, including migratory birds and colonial nesting birds. 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 (Lester et al. 2005; Holcomb et al. 2015).

A total of 104 bird species have been recorded within 1 mile of the project area at Shell Beach and the Hopedale Marina (**Figure 4-6**) (The Cornell Lab of Ornithology 2018). These species flycatchers, gulls, herons, kites, hawks, pelicans, night herons, egrets, sandpipers, sparrows, swallows, terns, shorebirds, waterfowl, and woodpeckers, as well as other song birds and shorebirds. Many of the bird species observed are those that would be expected to use the edge habitats between the emergent marshes and the surrounding uplands. Of the 104 bird species observed within 1 mile of the project area, 17 are listed as Birds of Conservation Concern by USFWS (**Table G-5** in **Appendix G**). These species represent the highest conservation priorities of USFWS beyond those currently designated as threatened or endangered.

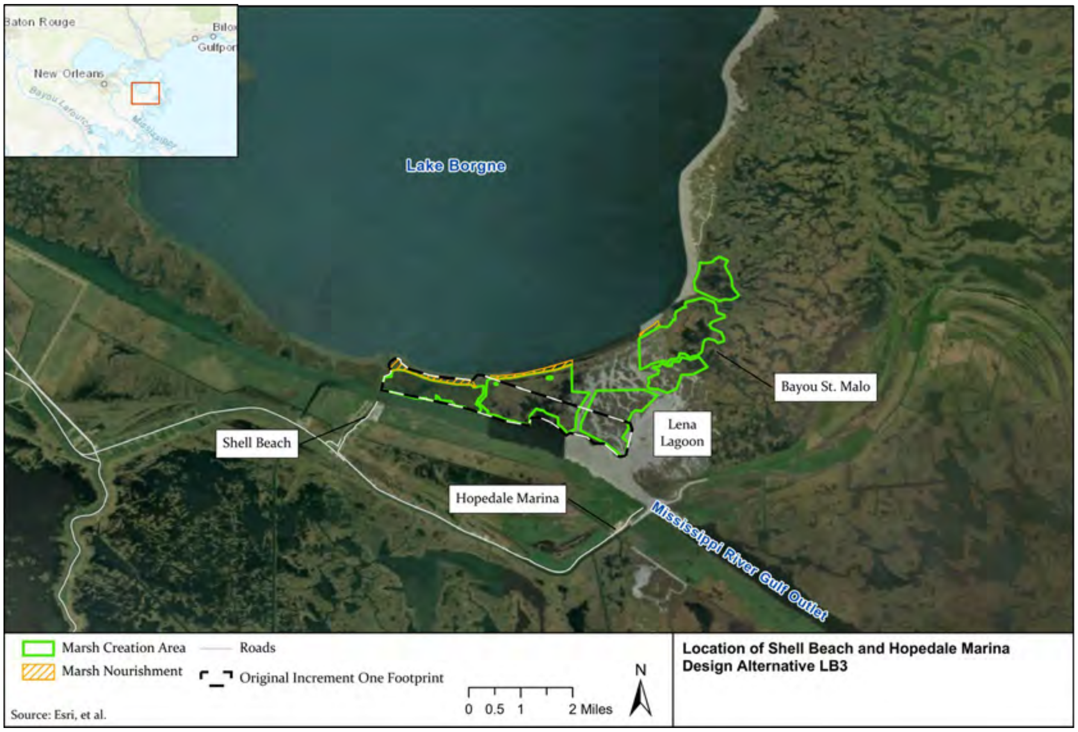


Figure 4-6. Location of Shell Beach and Hopedale Marina in Lake Borgne Project.

4.4.2.3.2 Environmental Consequences

Design Alternative LB3

Design Alternative LB3 could result in temporary displacement of birds during construction. These birds would need to find other areas to forage, loaf, and breed during this time. However, these impacts would be short-term, and suitable habitats are available nearby. Following the restoration, birds of the area should return quickly. Impacts to nesting, foraging, and overwintering habitat resulting from construction would be short-term, moderate, and adverse. BMPs could be implemented to minimize impacts to wildlife.

Design Alternative LB3 would result in long-term, beneficial effects to year-long, breeding, and overwintering bird species in the project area and the State of Louisiana. These benefits would result from the enhancement of and creation of marsh habitat that is important for the feeding, nesting, and roosting needs of migratory and non-migratory species. The enhanced and newly created 2,935 acres of marsh habitat would also create beneficial habitat for mammals, reptiles, and amphibians that rely on ridge and marsh habitats for all or part of their life cycle.

Design Alternative LB2

Under Design Alternative LB2, impacts to wildlife would be similar to Design Alternative LB3. Birds would be temporarily displaced during construction and would need to find other areas to forage, loaf, and breed during this time. These impacts would be short-term. Following the restoration, birds of the area should return quickly. 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.

Design Alternative LB2, as with Design Alternative LB3, would result in long-term, beneficial effects to bird species in the project area. These benefits would result from the enhancement of marsh habitat that is important for the feeding, nesting, and roosting needs of migratory and nonmigratory bird species. The enhanced and newly created habitats would also create beneficial habitat for mammals, reptiles, and amphibians that rely on marsh habitats for all or part of their life cycle.

No Action Alternative

Under the No Action Alternative, there would be no direct adverse impacts to wildlife. There would be long-term, adverse impacts to wildlife populations as marsh habitats continue to degrade within the project area to the point where fewer birds and other wildlife would use the marshes. Under the No Action Alternative, benefits from implementation of the Preferred Alternative would not occur.

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

4.4.2.3.1 Affected Environment

The water bodies and wetlands within and adjacent to the project area provide essential nursery and foraging habitats supportive of a variety of aquatic fauna, including economically important estuarine and saltwater species. Historically, shrimp generate the largest share of income followed by oysters, menhaden, blue crab, and striped mullet (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998). In addition, there are important recreational fisheries in Lake Borgne and adjacent areas for the species listed above and for spotted seatrout (*Cynoscion nebulosus*), sand seatrout (*Cynoscion arenarius*), black drum (*Pogonias cromis*), pompano (*Trachinotus carolinus*), and southern flounder (*Paralichthys lethostigma*).

The GMFMC, in cooperation with NMFS, has delineated EFH for federally managed species in coastal Louisiana (GMFMC 2005). The Lake Borgne project is located in Eco-Region 3 (NOAA 2015), and within the project area EFH has been designated for 11 species, including shrimp, fish, and sharks (see **Tables G-6** through **G-10** in **Appendix G**).

4.3.2.4.2 Environmental Consequences

Design Alternative LB3

Design Alternative LB3 includes the placement of fill material to raise soil elevations. This action would permanently impact select habitats within the MCAs. These existing habitats include marsh, channel, lagoon, and tidal open water habitats. Impacts to the MCAs and the borrow area may affect aquatic fauna, fisheries, and EFH and would alter present habitats. Therefore, Design Alternative LB3 would have long-term, minor, adverse impacts associated with the dredging, material transport, and placement. Disturbed and displaced aquatic fauna in these areas would likely find refuge in nearby suitable habitats. Conversely, for those species that depend on emergent marsh habitats, Design Alternative LB3 would increase the quantity and quality of emergent marsh habitat. The Lake Borgne project would provide long-term benefits to EFH with creation and restoration of 2,935 acres of optimal marsh habitat.

Dredging activities within the borrow area may have several impacts on EFH, including disruption of prey sources, noise disturbances, and impacts to spawning and feeding habitats due to turbidity and siltation. Impacts from dredging and transport of material are expected to be minimized because of the short distance from the borrow area to the fill area. The access routes have been established to avoid oyster sites and confine the transport of dredge material. Therefore, impacts resulting from dredging the borrow source area would cause short-term, minor, adverse impacts to aquatic fauna, fisheries, and EFH.

Potential impacts to estuarine and aquatic fauna, managed fisheries, and EFH would be considered, avoided, and minimized to the extent practicable during design and construction. When impacts cannot be avoided, BMPs would be implemented with the intent of minimizing the potential magnitude and duration of impacts to aquatic fauna, managed fisheries, and EFH. BMPs during construction would help to avoid and minimize impacts when protected and managed species are expected to be present or when most vulnerable. They would also likely include standard erosion and sediment control measures to protect water quality and aquatic habitats from impacts resulting from construction and sediment runoff. EFH consultation guidance documents on the NMFS webpage provide additional best practices to avoid or limit project impacts to EFH. Specific BMPs for the protection of EFH would be identified and selected based on project elements and chosen construction methods during the final engineering design. If the NMFS determines that effects of the proposed action require mitigation to EFH, a mitigation plan would be developed. The mitigation plan would identify appropriate mitigation that would be designed and implemented as appropriate.

Design Alternative LB3 would have short-term, minor to moderate, adverse effects on marine and estuarine aquatic fauna, EFH, crustaceans, mollusks, and other aquatic organisms due to construction. However, there would be long-term, beneficial impacts to these species and EFH due to the improvement and enhancement of marsh habitats. Temporary loss of EFH habitat would be offset by the creation of 2,935 acres of higher quality EFH emergent marsh.

Design Alternative LB2

Similar to Design Alternative LB3, Design Alternative LB2 would increase the quantity and quality of emergent marsh habitat in the project area. Impacts to these areas may affect aquatic fauna, fisheries, and EFH and would alter present habitats. Therefore, Design Alternative LB2 would have short-and long-term, minor, adverse impacts associated with placement of fill in the MCAs. As with Design Alternative LB3, Design Alternative LB2 would benefit fish species dependent on emergent marsh habitats by increasing the quantity and quality of emergent marsh habitat.

Design Alternative LB2 dredging activities would be similar to those of Design Alternative LB3. Therefore, impacts resulting from dredging the borrow source areas would cause short-term, minor, adverse impacts to aquatic fauna, fisheries, and EFH.

As with Design Alternative LB3, potential impacts to estuarine and 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, BMPs would be implemented with the intent of minimizing the potential magnitude and duration of impacts to aquatic fauna, managed fisheries, and EFH. BMPs during construction would help to avoid and minimize impacts when protected and managed species are expected to be present or when most vulnerable. Specific BMPs for the protection of EFH would be identified and selected based on project elements and chosen construction methods during the final engineering design. If the NMFS determines that effects of the proposed action require mitigation to EFH, a mitigation plan would be developed. The mitigation plan would identify appropriate mitigation that would be designed and implemented as appropriate.

Design Alternative LB2 would have short- and long-term, minor to moderate, adverse effects on marine and estuarine aquatic fauna, EFH, crustaceans, mollusks, and other aquatic organisms due to construction and habitat conversion. However, there would be long-term, beneficial impacts to most species and EFH due to the improvement, enhancement, and creation of marsh habitats. The loss of any EFH habitat would be offset by higher quality and higher quantities of EFH following marsh enhancement.

No Action Alternative

Under the No Action Alternative, no additional adverse or beneficial impacts to aquatic fauna, EFH, or managed fisheries would be expected in the short term. The conditions at the project site would remain largely the same in the short term but would continue to degrade over time due to erosive forces, subsidence, and sea level rise, resulting in long-term adverse impacts to the existing aquatic habitats at the Lake Borgne marsh. Benefits from implementation of the action alternatives would not occur.

4.4.3 Socioeconomic Environment

4.4.3.1 Fisheries and Aquaculture

Lake Borgne is open to recreational and commercial fishing. There are approximately 14,380 acres of private oyster grounds and nearly 182,926 acres of public oyster grounds within the Bienvenue-Proctor Point Marsh, Biloxi Marsh, and Lake Borgne EMUs (St. Bernard Parish 2012). Within the Biloxi Marsh EMU, primary fish and shellfish nursery grounds are located within the Bienvenue-Proctor Point Marsh and Biloxi Marsh EMUs (St. Bernard Parish 2012). Existing oyster leases are present within the project area.

4.4.3.1.1 Environmental Consequences

Design Alternative LB3

Design Alternative LB3 could result in short-term, minor, adverse impacts to fisheries and aquaculture during construction. However, such impacts would be minimized through BMPs, and all stipulations and procedures outlined in the applicable permits would be followed accordingly. Existing oyster leases would be avoided to the extent practicable.

Design Alternative LB2

Under Design Alternative LB2, impacts to fisheries and aquaculture would be similar to those under Design Alternative LB3, including the short-term, minor, adverse impacts to fisheries and aquaculture during construction.

No Action Alternative

Under the No Action Alternative, no changes to the Lake Borgne marshes and shorelines would occur. Thus, the No Action Alternative would result in no short-term impacts to recreational or commercial fisheries and aquaculture. However, potential adverse impacts to fisheries and aquaculture may occur over the long term as a result of the continued degradation and loss of suitable marsh habitat for many commercially important species.

4.5 Cumulative Impacts: Spanish Pass Project and Lake Borgne Marsh Project

4.5.1 Potential Cumulative Impacts

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertake such other actions" (40 CFR § 1508.7). As stated in the Council on Environmental Quality (CEQ) handbook, *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful. The following section describes the multistep approach used for evaluating cumulative impacts of the Proposed Alternatives for the Lake Borgne Marsh Creation Project Increment One and the Spanish Pass Increment project.

4.5.2 Methodology for Assessing Cumulative Impacts

Cumulative impacts were evaluated in a manner that was consistent with the methods developed for the Final PDARP/PEIS (DWH Trustees 2016a). Cumulative impacts were analyzed using four steps:

- Step 1 – Identify resources affected.
- Step 2 – Establish boundaries. Appropriate spatial and temporal boundaries may vary for each resource.
- Step 3 – Identify a cumulative action scenario.
- Step 4 – Analyze cumulative impacts.

4.5.2.1 Identification of Resources Affected and Boundaries of Analyses

4.5.2.1.1 Resources Affected

Cumulative impacts include each of the resources identified in the Physical Environment, Biological Environment, and Socioeconomics and Environmental Justice sections discussed previously. For several resources, the Preferred Alternatives would have no effects, negligible effects, or only short-term, minor effects and, based on their magnitude with respect to context and intensity, would not contribute to cumulative impacts. Therefore, these resources were not included in the cumulative impacts analysis. **Table 4-11** shows the resources excluded from the cumulative impacts analysis and the resources analyzed for potential environmental consequences that could result from the Preferred Alternatives.

Table 4-11. Resources Addressed in the Cumulative Impacts Analysis.

Resources Analyzed for Potential Environmental Consequences	Resources Excluded from the Cumulative Impacts Analysis
▪ Geology and substrates ▪ Hydrology and water quality ▪ Habitats ▪ Wildlife species ▪ Protected species ▪ Marine and estuarine fauna, EFH, and managed fish species ▪ Land and marine management ▪ Public health and safety, including flood and shoreline protection	▪ Air quality ▪ Noise ▪ Socioeconomics and environmental justice ▪ Cultural resources ▪ Fisheries and aquaculture ▪ Marine transportation ▪ Tourism and recreational use ▪ Aesthetics and visual resources

4.5.2.1.2 Spatial Boundary of Analysis

For this analysis, the spatial boundary includes those areas where the two Proposed Alternatives would occur and adjacent areas, focusing on actions occurring along, on, and within the vicinity of the two project areas.

4.5.2.1.3 Temporal Boundary of Analysis

Future actions are identified as those actions that are reasonably foreseeable and likely to contribute to the overall cumulative impacts, which include projects that have overlapping impacts with the Proposed Alternative for each project area. These include projects that are likely to be started prior to finalization of this Phase 2 RP/EA #1.2 and actions that are likely to occur after finalization of this plan.

4.5.3 Cumulative Action Scenario

Past, present, and reasonably foreseeable future actions near the two project areas were identified to effectively consider the potential cumulative impacts. A list of past, existing, and future projects was compiled for each project using state, USACE, EPA, USFWS, USDA, and NOAA databases and internet searches, as needed, for more detail. The project areas are coastal, and regulations pertaining to coastal permits were considered appropriate for developing a list of past and reasonably foreseeable future activities that may affect the resources. Based on information obtained from permitting databases, past and potential future activities near the project area include beach nourishment, road maintenance, additional recreational improvements, and pipeline installation.

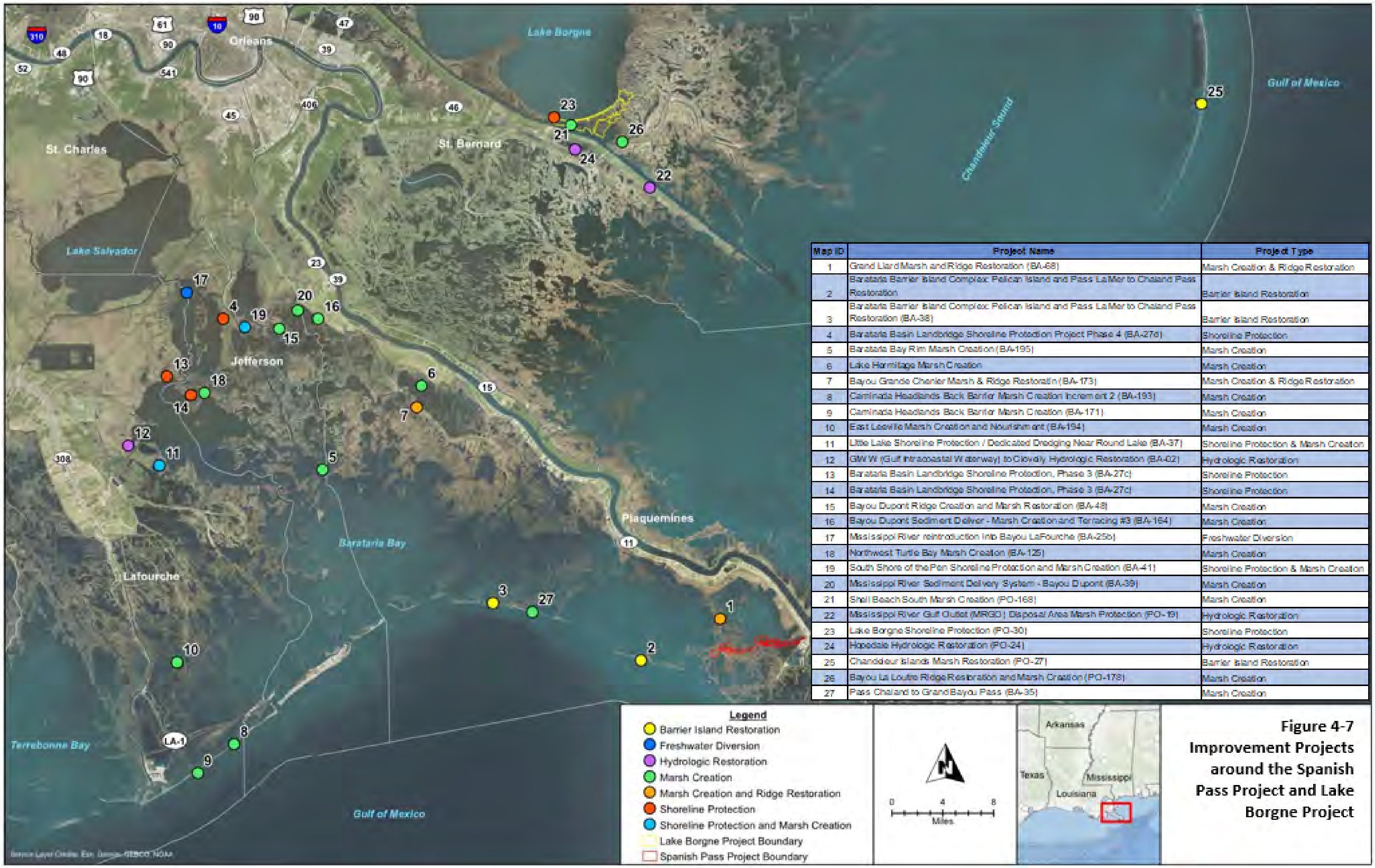
Based on the assessment summarized in **Figure 4-7** and **Table 4-12**, the resource areas with potential for cumulative impacts are geology and substrates; hydrology and water quality; habitats; wildlife species; protected species; marine and estuarine fauna, EFH, and managed fish species; land and marine management; and public health and safety. The Preferred Alternative for each project would create long-term benefits to these resources and some short-term, adverse impacts. The anticipated short-term, adverse impacts to geology and substrates, water quality, habitats, wildlife, and protected species from construction could be minimized with the development and implementation of BMPs.

For impacts to Gulf sturgeon critical habitat in Lake Borgne, the LA TIG will request a formal consultation from NMFS to address adverse effects from dredging in the borrow areas due to this and other projects that might use the Lake Borgne borrow source. This would include analysis of BMPs that could be implemented to minimize any impacts to Gulf sturgeon critical habitat, as well as a more detailed analysis of the timeframes for critical habitat to recover from any adverse impacts, as applicable. Any terms and conditions resulting from this consultation will be incorporated into the final design, and all required consultations would be completed prior to alternative implementation.

The cumulative effects from the two Preferred Alternatives and the identified actions are expected to result in cumulative beneficial impacts to:

- Geology and substrates
- Hydrology and water quality
- Habitats
- Wildlife species
- Marine and estuarine fauna, EFH, and managed fish species
- Protected species
- Land and marine management
- Public health and safety

Therefore, the cumulative impacts of the two Preferred Alternatives are expected to have a net positive effect on environmental resources.



Map ID	Project Name	Project Type
1	Grand Liard Marsh and Ridge Restoration (BA-68)	Marsh Creation & Ridge Restoration
2	Barataria Barrier Island Complex: Pelican Island and Pass La Mer to Chaland Pass Restoration	Barrier Island Restoration
3	Barataria Barrier Island Complex: Pelican Island and Pass La Mer to Chaland Pass Restoration (BA-38)	Barrier Island Restoration
4	Barataria Basin Landbridge Shoreline Protection Project Phase 4 (BA-27d)	Shoreline Protection
5	Barataria Bay Rim Marsh Creation (BA-195)	Marsh Creation
6	Lake Hermitage Marsh Creation	Marsh Creation
7	Bayou Grande Chenier Marsh & Ridge Restoratin (BA-173)	Marsh Creation & Ridge Restoration
8	Caminada Headlands Back Barrier Marsh Creation Increment 2 (BA-193)	Marsh Creation
9	Caminada Headlands Back Barrier Marsh Creation (BA-171)	Marsh Creation
10	East Leeville Marsh Creation and Nourishment (BA-194)	Marsh Creation
11	Little Lake Shoreline Protection / Dedicated Dredging Near Round Lake (BA-37)	Shoreline Protection & Marsh Creation
12	GIWW (Gulf Intracoastal Waterway) to Clovelly Hydrologic Restoration (BA-02)	Hydrologic Restoration
13	Barataria Basin Landbridge Shoreline Protection, Phase 3 (BA-27c)	Shoreline Protection
14	Barataria Basin Landbridge Shoreline Protection, Phase 3 (BA-27c)	Shoreline Protection
15	Bayou Dupont Ridge Creation and Marsh Restoration (BA-48)	Marsh Creation
16	Bayou Dupont Sediment Deliver - Marsh Creation and Terracing #3 (BA-164)	Marsh Creation
17	Mississippi River reintroduction Into Bayou LaFourche (BA-25b)	Freshwater Diversion
18	Northwest Turtle Bay Marsh Creation (BA-125)	Marsh Creation
19	South Shore of the Pen Shoreline Protection and Marsh Creation (BA-41)	Shoreline Protection & Marsh Creation
20	Mississippi River Sediment Delivery System - Bayou Dupont (BA-39)	Marsh Creation
21	Shell Beach South Marsh Creation (PO-168)	Marsh Creation
22	Mississippi River Gulf Outlet (MRGO) Disposal Area Marsh Protection (PO-19)	Hydrologic Restoration
23	Lake Borgne Shoreline Protection (PO-30)	Shoreline Protection
24	Hopedale Hydrologic Restoration (PO-24)	Hydrologic Restoration
25	Chandeleur Islands Marsh Restoration (PO-27)	Barrier Island Restoration
26	Bayou La Loutre Ridge Restoration and Marsh Creation (PO-178)	Marsh Creation
27	Pass Chaland to Grand Bayou Pass (BA-35)	Marsh Creation

Figure 4-7. Improvement Projects around the Spanish Pass Project and Lake Borgne Project.

Table 4-12. Past, Present, and Reasonably Foreseeable Future Actions Included in the Cumulative Impacts Analysis.

Category/Projects	Key Resource Areas with Potential Cumulative Impacts
Barrier Island Restoration Freshwater Diversion	Short-term, adverse impacts: ▪ Geology and substrates ▪ Hydrology and water quality ▪ Habitats ▪ Wildlife species ▪ Marine and estuarine fauna, EFH, and managed fish species ▪ Protected species Long-term, adverse impacts: ▪ No applicable impacts identified Long-term, beneficial impacts to: ▪ Habitats ▪ Wildlife species ▪ Protected species ▪ Land and marine management ▪ Tourism and recreational use ▪ Aesthetics and visual resources ▪ Public health and safety, including flood and shoreline protection
Hydrologic Restoration Marsh Creation Ridge Restoration Shoreline Protection	Short-term, adverse impacts: ▪ Geology and substrates ▪ Hydrology and water quality ▪ Habitats ▪ Wildlife species ▪ Marine and estuarine fauna, EFH, and managed fish species ▪ Protected species Long-term, adverse impacts: ▪ No applicable impacts identified Long-term, beneficial impacts to: ▪ Geology and substrates ▪ Hydrology and water quality ▪ Habitats ▪ Wildlife species ▪ Marine and estuarine fauna, EFH, and managed fish species ▪ Protected species ▪ Tourism and recreational use ▪ Land and marine management ▪ Aesthetics and visual resources ▪ Public health and safety, including flood and shoreline protection
Road Maintenance	Short-term, adverse impacts to: ▪ Geology and substrates ▪ Hydrology and water quality ▪ Habitats ▪ Wildlife species Long-term, adverse impacts: ▪ No applicable impacts identified Long-term, beneficial impacts to: ▪ Infrastructure ▪ Land and marine management ▪ Tourism and recreational use ▪ Aesthetics and visual resources ▪ Public health and safety, including flood and shoreline protection

Category/Projects	Key Resource Areas with Potential Cumulative Impacts
Recreational Improvements	Short-term, adverse impacts to: ▪ Geology and substrates ▪ Habitats ▪ Wildlife species ▪ Protected species Long-term, adverse impacts to: ▪ Habitats ▪ Wildlife species ▪ Protected species Long-term, beneficial impacts to: ▪ Infrastructure ▪ Land and marine management ▪ Tourism and recreational use ▪ Aesthetics and visual resources

4.5.4 Cumulative Impacts of the No Action Alternatives

Under the No Action Alternative for both project areas, the existing ridges and marshes would remain in their current state. The two project areas would be impacted in the future by erosion, local subsidence, and sea level rise, which could inundate the areas. When the No Action Alternative is analyzed in combination with other past, present, and reasonably foreseeable future actions, short- and long-term, adverse, cumulative impacts on hydrology and water quality; wildlife; habitats; and marine and estuarine fauna, EFH, and managed fish species would likely occur. There would be continued degradation of marsh habitat and coastal zone buffering. Therefore, the No Action Alternative for both the Lake Borgne Marsh Creation Project Increment One and the Spanish Pass Increment projects would be expected to contribute to adverse, cumulative impacts on environmental resources.

Under the No Action Alternative for both projects, the following resources are expected to be adversely impacted:

- Hydrology and water quality
- Habitats
- Wildlife species
- Marine and estuarine fauna, EFH, and managed fish species
- Protected species
- Land and marine management
- Public health and safety

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Section 5

Compliance with Other Laws and Regulations

In addition to the requirements of OPA and NEPA, other laws may apply to the proposed alternatives in the Phase 2 RP/EA #1.2. The LA TIG will ensure compliance with the following applicable laws or executive orders. Additional detail on each of these laws or executive orders can be found in Chapter 6 of the Final PDARP/PEIS (DWH Trustees 2016a). 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 2016a). That material is incorporated by reference here.

5.1 Federal Laws

Additional federal laws, regulations, and executive orders 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 (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.)
- Rivers and Harbors Act (33 U.S.C. §§ 401 et seq.)
- Marine Protection, Research and Sanctuaries Act
- Archaeological Resource Protection Act
- National Marine Sanctuaries Act
- Farmland Protection Policy Act
- EO 11988: Floodplain Management (as augmented by EO 13690, January 30, 2015)
- EO 11990: Protection of Wetlands
- EO 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- EO 12962: Recreational Fisheries
- EO 13112: Safeguarding the Nation from the Impacts of Invasive Species
- EO 13175: Consultation and Coordination with Indian Tribal Governments
- EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds
- EO 13693: Planning for Federal Sustainability in the Next Decade
- Fish and Wildlife Coordination Act (16 U.S.C. §§ 661–666)
- Estuary Protection Act

Federal environmental compliance responsibilities and procedures will follow the *Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the Deepwater Horizon (DWH) Oil Spill* (DWH Trustees 2016b). By following these standard operating procedures, the Implementing Trustee for each project will ensure that the status of environmental compliance is tracked through the Restoration Portal. Implementing Trustees will keep a record of compliance documents and ensure they are submitted for inclusion to the Administrative Record.

5.2 Compliance with State and Local Laws

The LA TIG will ensure 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 (Louisiana Revised Statute [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

5.3 Summary and Next Steps

Following public review, the LA TIG intends to select a design alternative for completion and prepare for final design and construction. The LA TIG has started environmental compliance technical assistance and reviews with the applicable state and federal agencies. Early discussions indicate that formal ESA consultation with NMFS will be needed for the Lake Borgne preferred alternative due to proposed dredging within Gulf sturgeon designated critical habitat.

The LA TIG would ensure compliance reviews/approvals under all applicable state and local laws and other applicable federal laws and regulations relevant to the selected design alternative are complete before implementation. Implementing Trustees are required to implement alternative-specific mitigation measures, including BMPs and conditions identified in this Phase 2 RP/EA #1.2 and completed consultations/permits. Implementing Trustees would provide oversight with regard to ensuring no unanticipated effects to protected species and habitats occur, including ensuring that BMPs and conditions are implemented and continue to function as intended. A summary of environmental compliance status will be provided in the final Phase 2 RP/EA #1.2.

Appendix A

List of Repositories

Table A-1. List of Repositories.

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

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Appendix B

List of Preparers, Agencies, and Persons Consulted

Table B-1. List of Preparers, Agencies, and Persons Consulted

Participant	Agency/Firm	Name	Position
State of Louisiana	LDWF	Todd Baker	Assistant Chief
State of Louisiana	LDWF	Brady Carter	Program Manager of Fisheries Habitat Section
State of Louisiana	CPRA	Caitlin Glymph	Coastal Resources Scientist
State of Louisiana	CPRA	Matt Mumfrey	Attorney
National Oceanic and Atmospheric Administration	Restoration Center	Christina Fellas	DWH Environmental Compliance Coordinator/Biologist
National Oceanic and Atmospheric Administration	Restoration Center	Ramona Schreiber	DWH NEPA Coordinator
National Oceanic and Atmospheric Administration	Restoration Center/Earth Resources Technology, Inc.	Courtney Schupp	Marine Habitat Resource Specialist
U.S. Department of Agriculture	NRCS	Ronald Howard	Program Specialist
U.S. Department of Agriculture	NRCS	Mark Defley	Biologist
U.S. Department of the Interior	DOI	Robin Renn	DWH NEPA Coordinator
U.S. Department of the Interior	DOI	John Tirpak	Louisiana Restoration Area Coordinator
US Environmental Protection Agency	US EPA	Doug Jacobson	EPA Team Leader
US Environmental Protection Agency	US EPA	Patty Taylor	Environmental Engineer
Contractor Team	CDM Smith	Brendan Brown	Senior Biologist
Contractor Team	CDM Smith	Murray Wade	Senior Biologist
Contractor Team	CDM Smith	Larry Schwartz	Biologist/Ecologist Specialist
Contractor Team	CDM Smith	Matt Petty	Biologist/Ecologist Specialist
Contractor Team	CDM Smith	Adam Khalaf	Biologist/Ecologist
Contractor Team	CDM Smith	Traci Mordell	Technical Editor
Contractor Team	CDM Smith	Melissa Vagi	Technical Editor
Contractor Team	CDM Smith	Kim Brotzge	Administrative
Contractor Team	Royal Engineers and Consultants	Kirk Rhinehart	Principal
Contractor Team	Royal Engineers and Consultants	Hunter Guidry	Senior Scientist
Contractor Team	Royal Engineers and Consultants	Levi LeBourgeois	Project Scientist

Participant	Agency/Firm	Name	Position
Contractor Team	Royal Engineers and Consultants	Angella Carrier	Project Manager
Contractor Team	Royal Engineers and Consultants	Mandy Green	Senior Scientist
Contractor Team	Lynker Technologies	Cameron Wobus	Senior Scientist
Contractor Team	Lynker Technologies	Bill Szafranski	Project Scientist
Contractor Team	Lynker Technologies	Megan O'Grady	Project Scientist

Appendix C

Acronyms

Acronym	Definition
BMP	best management practice
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Cornell	The Cornell Lab of Ornithology
CPRA	Coastal Protection and Restoration Authority
CWPPRA	Coastal Wetlands Planning, Protection and Restoration Act
CZM	Coastal Zone Management
DOI	U.S. Department of the Interior
DWH	Deepwater Horizon
E&D	engineering and design
EA	environmental assessment
EFH	essential fish habitat
EMU	environmental management unit
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
Final PDARP/PEIS	Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement
GMFMC	Gulf of Mexico Fishery Management Council
HDDA	Hopper Dredge Disposal Area
La. Admin. Code	Louisiana Administrative Code
La. Rev. Stat.	Louisiana Revised Statute
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDWF	Louisiana Department of Wildlife and Fisheries
MBTA	Migratory Bird Treaty Act
MCA	marsh creation area
MCY	million cubic yards
MRGO	Mississippi River Gulf Outlet
NAAQS	National Ambient Air Quality Standards
NAVD 88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NRDA	Natural Resource Damage Assessment
NRHP	National Register of Historic Places
OPA	Oil Pollution Act of 1990
RP	restoration plan
TIG	trustee implementation group

Acronym	Definition
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordinance

Appendix D

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Appendix E

Guidelines for NEPA Impact Determinations in the Final PDARP/PEIS

Table 6.3-2. Guidelines for NEPA impact determinations in the Final PDARP/PEIS.

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
Physical Resources				
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	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.	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.

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
		connectivity could occur; however, wetland function could not be affected and natural restoration could occur if left alone.	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.	
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.
Biological Resources				
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 range-wide 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	Impacts on native vegetation could be measureable 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	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 range-wide 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

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
		temporary and localized and could not displace native species populations and distributions.	limited to local and adjacent areas, but could only result in temporary changes to native species population and distributions.	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 range-wide 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 measureable 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 range-wide 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 demographic 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.
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	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-	Impacts could be readily apparent and could substantially change marine and estuarine species populations over a wide-scale 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

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
		temporary and localized and these species could not displace native species populations and distributions.	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.	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.

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
Socioeconomic Resources				
Socioeconomics and Environmental Justice[a]	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.

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
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.
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 Transporta-tion	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).

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
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.

[a] Evaluation of potential environmental justice issues will be fully address in future tiered documents.

Appendix F

Monitoring and Adaptive Management Plans

Appendix F1
Monitoring and Adaptive Management Plan for the Spanish Pass Project

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project:

Barataria Basin Ridge and Marsh Creation Project - Spanish Pass Increment

Prepared by: Todd Folse, Coastal Protection and Restoration Authority of Louisiana

Draft Version Date: 9/19/2019

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1 Introduction

The Deepwater Horizon (DWH) Louisiana Trustee Implementation Group (TIG) developed this Monitoring and Adaptive Management Plan (Plan) for the Barataria Basin Ridge and Marsh Creation Project – Spanish Pass Increment (BA-0203) (Spanish Pass Project), which represents one of six projects selected from within the broader Final Restoration Plan #1: Restoration of Wetlands, Coastal, and Nearshore Habitats; Habitat Projects on Federally Managed Lands, and Birds (LA TIG 2017) in January 2017. The purpose of this Monitoring and Adaptive Management (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 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 towards achieving restoration goals and objectives;
2. Increase the likelihood of successful implementation through identification, before a project begins, of potential corrective actions that could be undertaken if the project does not proceed as expected;
3. Ensure the capture, in a systematic way, 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. For example, the MAM Plan may need to be revised should the project design change, if initial data analysis indicates that the sampling design requires adjustment, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any future revisions to the MAM Plan will be made publicly available through the Restoration Portal at the URL via the following link (https://www.diver.orr.noaa.gov/web/guest/home) and is also accessible through the Deepwater Horizon NRDA Trustees website via the following link: (https://www.gulfspillrestoration.noaa.gov/).

1.1 Project Overview

The Barataria Basin Ridge and Marsh Creation Project – Spanish Pass Increment (BA-0203) is located in Plaquemines Parish, Louisiana beginning west of Venice, LA (**Figure 1**) and extending

7.5 miles westward over degraded marsh and ridge habitat toward Bay Jacques. The project will restore approximately 1,794 acres of marsh and 139 acres of ridge (**Figure 1**) through strategic placement of dredge material. The elevation of each feature, marsh and ridge, will be determined in the Final Design Report which has not been developed as of this version of the MAM Plan. However, it is anticipated that the initial elevation of the marsh platform may be approximately +3.0 feet (NAVD88) whereas the ridge will be above +5.0 feet (NAVD88). Sediment for the marsh may be dredged from the Mississippi River as well as the Gulf of Mexico; whereas, the material used for the ridge may be from the Mississippi River or in-situ material. Upon completion of the project, suitable native shrub/woody vegetation will be planted on the ridge. It is anticipated that herbaceous vegetation will naturally establish within the first few years based on recently constructed restoration projects in the vicinity of the project, i.e., Grand Liard Marsh and Ridge Restoration (BA-0068), Lake Hermitage Marsh Creation (BA-0042 and BA-0141), and Bayou DuPont Marsh and Ridge Creation (BA-0048). However, vegetative plantings on the marsh platform may occur if natural succession does not occur as anticipated (see Section 5 on corrective actions).

Figure 1. Spanish Pass Ridge and Marsh Creation Project

This project is being implemented as restoration for the *Deepwater Horizon* oil spill Natural Resource Damage Assessment (NRDA), consistent with the PDARP/PEIS (Deepwater Horizon Natural Resource

Damage Assessment Trustees. 2016). Per the PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Restore and Conserve Habitat
- **Restoration Type:** Wetlands, Coastal, and Nearshore Habitats
- **Restoration Approach:** Create, Restore, and Enhance Coastal Wetlands
- **Restoration Technique:** Create or enhance coastal wetlands through placement of dredged material
- **Trustee Implementation Group:** LA TIG
- **Restoration Plan:** Louisiana Trustee Implementation Group Final Restoration Plan #1.2: Barataria Basin Ridge and Marsh Creation Project Spanish Pass Increment and Lake Borgne Marsh Creation Project Increment One

The implementing state trustee is the Coastal Protection and Restoration Authority (CPRA) of Louisiana. The implementing federal trustee is the United States Department of Interior, represented by the U. S. Fish and Wildlife Service (USFWS).

1.2 Restoration Type Goals and Project Restoration Objectives

The goal for the project is to create and restore wetlands, coastal and nearshore habitats in the Louisiana Restoration area (LA TIG, 2017) specifically along Spanish Pass. This area has been degraded due to eustatic sea level rise, high subsidence rates, diminished sediment supply, and extreme storm events. In restoring these coastal habitats, the Trustees envision that the project will compensate, in part, for wetlands, coastal and nearshore habitat losses associated with the spill.

1.2.1 Restoration Type Goals

As summarized in the PDARP/PEIS, Chapter 5, the restoration goals for injuries to coastal habitats are as follows:

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

1.2.2 Project Restoration Objectives

To help meet the restoration goals for injuries to coastal habitats, the project restoration objective is to create and nourish 139 acres of historic ridge and 1,794 acres of marsh that have been degraded due to sea-level rise, high subsidence rates, diminished sediment supply, and extreme storm events. The degree to which this restoration objective is met will be evaluated via measurements of the following parameters:

- Parameter #1: Spatial Extent (acres) of marsh and ridge creation
- Parameter #2: Elevation of marsh and ridge areas
- Parameter #3: Vegetative Cover
- Parameter #4: Invasive Species Cover
- Parameter #5: Soil Samples

These parameters will be monitored according to the monitoring schedule summarized in Section 2.

Throughout the design process, project team members, including but not limited to CPRA 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 Spanish Pass Project is located in Plaquemines Parish, Louisiana west of Venice, LA, and follows an historical distributary of the Mississippi River approximately 7.5 miles westward over degraded marsh and ridge habitat toward Bay Jacques. Coastal erosion and sea level have caused significant degradation of these ridge and marsh habitats. Marsh creation projects like the one proposed here could help to build and maintain these habitats through time. The conceptual setting for the Spanish Pass project is summarized in Section 2.2.2 of the *Louisiana Trustee Implementation Group Final Restoration Plan #1* (LA TIG 2017) and is incorporated here by reference.

1.3.1 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR § 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., sediment compaction or vegetation success). For the Spanish Pass Project, the uncertainties summarized in **Table 1** could affect project success, and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2-3 summarize project monitoring data and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees utilized a variety of sources, including but not limited to PDARP/PEIS Restoration Type MAM sections (Deepwater Horizon Natural Resource Damage Assessment Trustees. 2016), Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0 (*Deepwater Horizon* (DWH) Natural Resource Damage Assessment Trustees. 2017), 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 1**).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision-Making
1	Sea level rise, subsidence, sediment compaction	Increased flooding of the marsh platform would reduce the growth and cover of herbaceous plant species and increase the coverage of submerged aquatic species or increase the open-water area. Increased flooding on the ridge feature would prevent shrub/woody establishment or cause the habitat to convert to herbaceous marsh.
2	Soil composition for ridge feature	The borrow area material may be high in sand content because the borrow source is the Mississippi River. A high sand content may present difficulties for woody species to become established due to the lack of water-holding capacity and nutrients.
3	Success of vegetation establishment/plantings	Lack of vegetation establishment/planting success would limit or delay the creation of the desired habitat.
4	Herbivory	Young tender plants, either through natural succession or vegetative plantings, are desired by some species as a source of food. Herbivory may cause the increase of planting efforts by requiring devices to reduce plant consumption. Also, would delay the establishment of vegetation and habitat creation.

2 Project Monitoring

The MAM Plan was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed, for the first 5 years after the project’s construction. The data collected during this 5-year period will also be used to predict the project’s performance during the remaining 15-years of the project's 20-year design life. This section summarizes the project monitoring parameters that will be used to evaluate performance through time. For each of the identified monitoring parameters, information is provided as to its intended purpose (e.g., to monitor progress toward meeting one or more of the restoration objectives or to 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 Section 5, Project-Level Decisions).

The *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0* (*Deepwater Horizon* (DWH) Natural Resource Damage Assessment Trustees. 2017) recommends project-level monitoring be conducted at reference or control sites. The CPRA currently maintains a monitoring program that provides ecological data and research to support the planning, design, construction, evaluation, and adaptive management of Louisiana's wetland restoration projects (Folse et al. 2018). This Coast-wide Reference Monitoring System-Wetlands (CRMS) was developed and implemented to improve the monitoring program's effectiveness in evaluating individual restoration projects, as well as the combined effects of multiple projects by providing a network of reference sites where data are collected on a regular basis (Steyer et al. 2003). In conjunction with CRMS, several coastal restoration projects have been constructed recently in the vicinity of the Project. Data on vegetation, water level, salinity, elevation, and/or habitat mapping or land-water analysis, from these projects will provide information regarding performance. Data for the project will be collected similarly for comparison, and data results from the projects will be used to compare project performances. The projects that have been constructed are Grand Liard Marsh and Ridge Restoration (BA-0068), Lake Hermitage Marsh Creation (BA-0042 and BA-0142), and Bayou DuPont Marsh and Ridge Restoration (BA-0068).

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 to monitor project success:

- Parameter #1: Spatial Extent (acres) of marsh and ridge creation
  a) Purpose: To determine how many acres of marsh and ridge were created
  b) Method: Acquire and orthorectify high-resolution, near-vertical aerial imagery
  c) Timing, Frequency, and Duration: Immediate post-construction/as-built – will occur soon after construction activities conclude; Years (YRs) 3 and 5 post-construction - will occur during the Fall of the respective years
  d) Sample Size: Aerial imagery will be acquired for the entire project area and some surrounding areas
  e) Sites: Project area

- Parameter #2: Elevation of marsh and ridge areas
  a) Purpose: To determine that the average elevation is achieved per the design specifications for construction and to verify the elevation of the sediment is as expected per the design curves in the final design report at YRs 3 and 5 post-construction.
  b) Method: LiDAR and/or RTK topographic surveys
  c) Timing, Frequency, and Duration: Surveys will be conducted during construction (before and after sediment placement) and at YRs 0, 3, and 5 post-construction.
  d) Sample Size: Construction surveys will be conducted on transects spaced every 250 feet apart or as specified in the construction documents. YR0 would utilize LiDAR and/or RTK as little to no vegetation is expected. YRs 3 and 5 transects may be spaced 500, 750, and/or 1,000 feet apart, but have yet to be determined.
  e) Sites: Throughout the project area

- Parameter #3: Vegetative Cover
  a) Purpose: To determine the herbaceous percent cover in the marsh and to determine the shrub/woody percent cover on the ridge
  b) Method:
     1. Ridge: Ocular estimates (Folse et al., 2018) using 6 meter by 6 meter plots randomly placed along transects throughout the project area
     2. Marsh: Ocular estimates (Folse et al., 2018) using 2 meter by 2 meter plots randomly placed along transects throughout the project area. Includes cover and species present.
  c) Timing, Frequency, and Duration:
     1. Ridge: First growing season after planting and YRs 3 and 5 post-construction. Sampling will occur between mid-August and mid-November with the target being September/October.
     2. Marsh: First growing season after planting and YRs 3 and 5 post-construction. Sampling will occur between mid-August and mid-November with the target being September/October.
  d) Sample Size: To be determined
  e) Sites: Project area; CRMS sites and restoration projects having similar habitats will be used as references

- Parameter #4: Invasive Species Cover
  a) Purpose: To determine invasive species percent cover in the marsh and ridge
  b) Method:

1. Ridge: Ocular estimates (Folse et al., 2018) using 6 meter by 6 meter plots randomly placed along transects through the project area; same plots as parameter #3: vegetation cover
2. Marsh: Ocular estimates (Folse et al., 2018) using 2 meter by 2 meter plots randomly placed along transects through the project area; same plots as parameter #3: vegetative cover

c) Timing, Frequency, and Duration:
1. Ridge: Same as Parameter #3: Vegetative Cover
2. Marsh: Same as Parameter #3: Vegetative Cover

d) Sample Size: To be determined

e) Sites: Project area; CRMS sites and restoration projects having similar habitats will be used as references

➢ Parameter #5: Soil Samples

This parameter may be collected but will not be used as a performance criteria. Field observations of vegetative establishment and growth will determine when and if soil samples will be collected. CPRA has not constructed many coastal restoration projects with a ridge component, and the few that have been constructed have been constructed relatively recently. Therefore, there is little to no available data for this parameter or component performance.

a) Purpose: To determine soil pH, soil salinity, bulk density, soil moisture, percent organic matter, wet/dry volume, and potentially percent sand, silt and clay of ridge soils if woody/shrub species are not becoming established, are dying, or are not increasing in total vegetative cover.

b) Method:
1. Collection: The collection of soils will follow the Coast-wide Reference Monitoring System-Wetland (Folse et al. 2018), except soil cores may be sliced in different intervals.
2. Analytical: Samples will be sent off to a certified laboratory for testing. Appropriate tests will be conducted for each variable.

c) Timing, Frequency, and Duration:
1. If collected, samples will be collected in August – November at the time of the ridge vegetation data collection effort.

d) Sample Size: To be determined

e) Sites: Project area

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 2**).

1. 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 Spanish Pass project, 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.
2. 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 the Spanish Pass 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.
3. 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.
4. 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

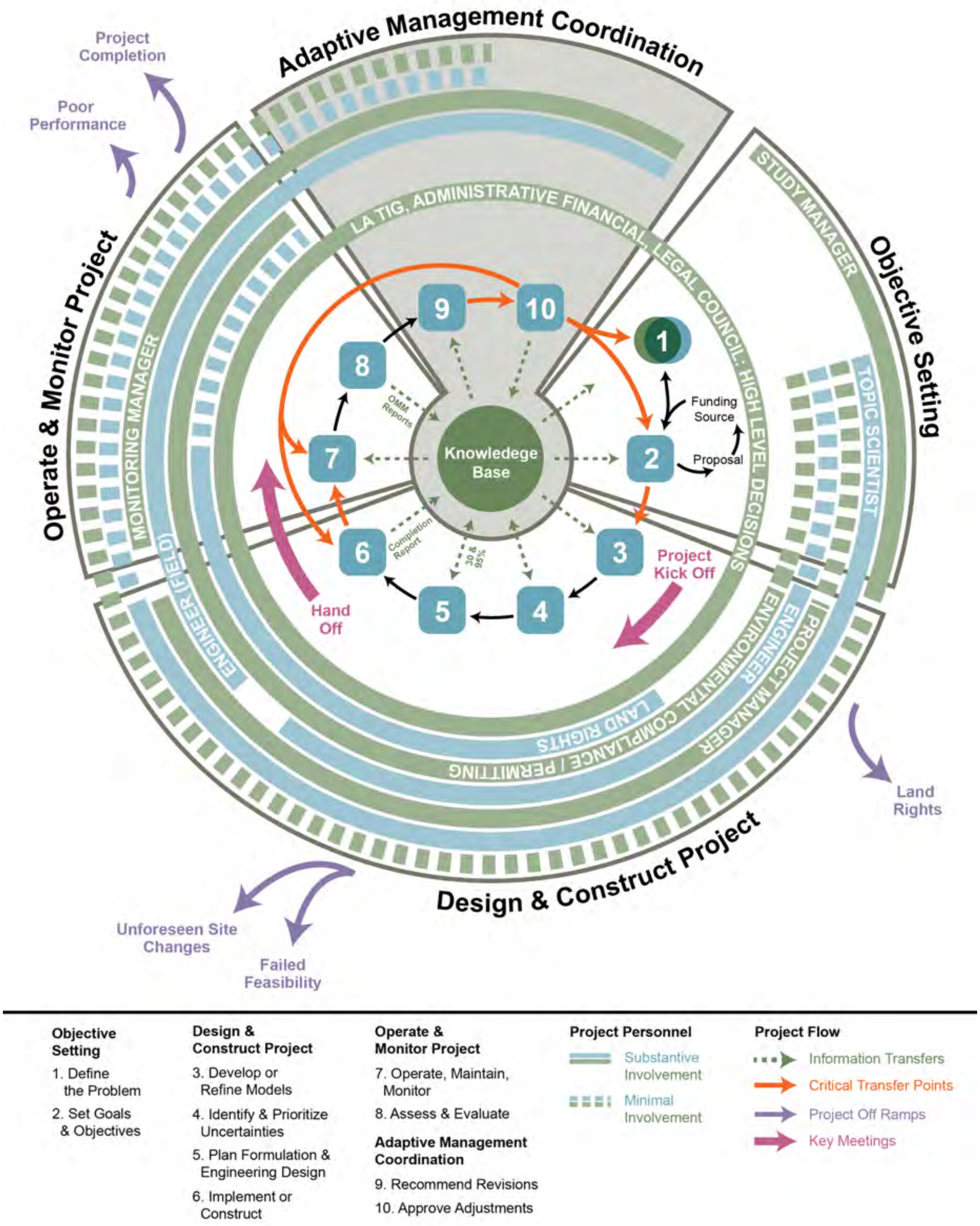

Figure 2. LA TIG Adaptive Management Cycle (Source: The Water Institute of the Gulf, 2019)

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. Reports, presentations, and/or lesson learned meetings are potential avenues of transferring information to the LA TIG and other agency personnel about project performances.

The results of these analyses would be used to answer the following questions and included within the reports described in section 8:

- 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 are grouped below by monitoring parameters:

Parameter #1: Spatial Extent (acres) of marsh and ridge

Analysis: Aerial imagery, elevation, and/or vegetation data sets collected for the project will be used to determine habitat evolution and acreages. Aerial imagery will be analyzed for land – water composition. Elevation data and vegetation data will be used to determine habitat types.

Parameter #2: Elevation of marsh and ridge areas

Analysis: The project's Final Design Report will establish the desired elevation of each feature in order for appropriate herbaceous or woody specie to colonize and create appropriate habitat. Data will be analyzed for the average elevation in each habitat. Other mapping products such as triangulated irregular network (TIN) models could be generated in Geographical Information System (GIS) software packages along with digital elevation models (DEM) to show the elevation across the project area. Over time, differences amongst the individual models would show elevation changes.

The constructed target elevations for marsh and ridge habitats will be determined using the methodology(ies) in CPRA's Marsh Creation Design Guidelines (2017). These elevations use various data sources such as water elevation, sea-level rise, and subsidence. At YRs 3 and 5, data will be analyzed using the same methods and updated data (current water elevations and habitat elevations) to determine if the habitat is within the optimal marsh inundation ranges for habitat development. The same water level gauges used in the Final Design Report will be used for YRs 3 and 5, if still active.

The average elevation will be determined using YRs 3 and 5 data sets to determine if these elevations are as predicted in the project settlement curves that will be published in the Final Design Report.

Parameter #3: Vegetative Cover

Analysis: 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 (marsh) and herbaceous and woody species (ridge); percent cover of species; and/or average height of dominant species. After each data collection effort, all collected and analyzed data will be evaluated to determine existing habitat type. After multiple data collection efforts, comparisons between each time period will be assessed to determine the evolution of the habitat. Data sets from other coastal restoration projects constructed using other funding sources will be analyzed for comparative performance purposes.

Parameter #4: Invasive Species Cover

Analysis: Data sets will be examined for invasive species. If invasive species are identified within the data set, the average percent cover will be calculated.

Parameter #5: Soil Samples

Analysis: Soil sample results will be analyzed for averages as well as examined individually to determine if the soils in some or all locations are the limiting factor for vegetative establishment, growth, and succession.

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

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 2** 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 2. List of Project Monitoring Parameters, Performance Criteria, and Potential Corrective Actions

Monitoring Parameter	Final Performance Criteria Used to Determine Project Success	Potential Corrective Actions
Spatial Extent	There willl be no more than the equivalent of 1.7% annual land loss rate between year 0 and 5 post-construction. (See note 1 after this table)	Planting of appropriate species
Elevation	The target elevations stated in the Final Design Report for marsh and ridge at the time of construction. (See note 2 after this table)	Addition or regrading of sediments
Vegetation Cover - Marsh Platform	Live vegetative cover is equal to or greater than 65% at Year 5	Planting of herbaceous species
Vegetation Cover- Ridge	30% cover of woody species at year 5 or >= to the BA-0068 project at year 5 (See note 3 after this table)	Planting of woody species
Invasive Species Cover	Average live vegetative cover of invasive species is not greater than 25% at Year 5.	Mechanical removal or herbicide application

1. The land loss rate of 1.7% was determined from a 12,000-acre polygon that encompasses the project area from 1984 to 2016 (Baird 2019).

2. The project is currently gathering data to make the final determination. The Final Design Report is scheduled for late 2019.

3. Grand Liard Marsh and Ridge Restoration (BA-68) Final (95%) Design Review Update: Project Information Sheet for Wetland Value Assessment (WVA).

6 Monitoring Schedule

The project monitoring schedule (**Table 3**) is separated by monitoring activities. Pre-execution monitoring will occur before any project construction activities occur, if applicable. Execution of monitoring will occur when the construction activities have been deemed complete. Performance monitoring will occur in the years following construction (YRs 0-5).

Table 3. Monitoring Schedule

Monitoring Parameters	Execution Monitoring Time (initial)	Post-Execution Monitoring Time (ongoing)				
	As Built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5
Vegetation Survey (marsh)	n/a	**X**	n/a	**X**	n/a	**X**
Vegetation Survey (ridge)	n/a	**X**	n/a	**X**	n/a	**X**
Elevation Survey	**X**	n/a	n/a	**X**	n/a	**X**
Aerial Imagery Acquisition	**X**	**O**	**O**	**X**	**O**	**X**
Soil Testing	**O**	**O**	**O**	**O**	n/a	**O**

Note: "X's" that are bold indicate required data acquisitions; "O's" that are bold indicate optional data acquisitions; "n/a" indicates not applicable.

7 Data Management

7.1 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 will 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).

7.2 Data Review and Clearance

Data will be reviewed for QA/QC in accordance with the *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0* (*Deepwater Horizon* (DWH) Natural Resource Damage Assessment Trustees. 2017), 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.

7.3 Data Storage and Accessibility

Once data have been cleared, they will be submitted to 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.

7.4 Data Sharing

Data will be made publicly available in accordance with the Federal Open Data Policy through the DIVER Explorer Interface within 1 year of when the data collection occurred. Also, data will be made available through the Coastal Protection and Restoration Authority's Coastal Information Management System (CIMS) database, which can be accessed at the URL at the following link (https://cims.coastal.louisiana.gov/default.aspx). Larger datasets such as LiDAR will be made available through portals appropriate for handling the associated file sizes.

8 Reporting

Based on the project monitoring schedule (Section 4), associated reporting will be submitted in post-construction YRs 2, 4, and 6 which represents one year after data collection efforts in YRs 1, 3, and 5. Each of these reports will primarily focus on answering the questions presented in

Section 4, Evaluation. The YR 1 and 3 reports will be more progress related reports; whereas, the YR 5 report will be comprehensive in nature and answer whether or not the project met each of the performance criteria (PC). If the project did not meet a PC, then an explanation will be provided. For each report, if corrective actions are required then a corrective action plan would be generated and variables would continue to be monitored.

The reports will follow the template recommended in the *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0* (*Deepwater Horizon* (DWH) Natural Resource Damage Assessment Trustees. 2017), Appendix D. MAM reports and lessons learned from the monitoring activities will be disseminated to the LA TIG through relevant portals, and information will be more broadly disseminated at conferences to reach a larger audience.

9 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. CPRA 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 review for implementation. The implementing Trustees' roles include:

- Data collection
- Data analysis
- Report composition
- Ensuring corrective action activities are performed, if necessary
- Providing project progress information to the LA TIG

10 Monitoring and Adaptive Management Budget

The overall budget for the project monitoring and adaptive management plan is $1,488,610 and covers the activities identified in Table 4 as well as data analysis, report composition, and project management.

11 References

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Appendix F2
Monitoring and Adaptive Management Plan for the Lake Borgne Project

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project:

Lake Borgne Marsh Creation Project - Increment 1

Prepared by: Todd Folse, Coastal Protection and Restoration Authority of Louisiana

Draft Version Date: 9/19/2019

Table of Contents

1 Introduction

The Deepwater Horizon (DWH) Louisiana Trustee Implementation Group (TIG) developed this Monitoring and Adaptive Management Plan (Plan) for the Lake Borgne Marsh Creation Project – Increment 1 (Lake Borgne Project), which represents one of six projects selected from within the broader Final Restoration Plan #1: Restoration of Wetlands, Coastal, and Nearshore Habitats; Habitat Projects on Federally Managed Lands, and Birds in January 2017. The purpose of this Monitoring and Adaptive Management (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 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 towards achieving restoration goals and objectives;
2. Increase the likelihood of successful implementation through identification, before a project begins, of potential corrective actions that could be undertaken if the project does not proceed as expected;
3. Ensure the capture, in a systematic way, 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. For example, the MAM Plan may need to be revised should the project design change, if initial data analysis indicates that the sampling design requires adjustment, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any future revisions to the MAM Plan will be made publicly available through the Restoration Portal, which can be accessed at the URL via the following link (https://www.diver.orr.noaa.gov/web/guest/home) and will also be accessible through the Deepwater Horizon NRDA Trustees website, which is located at the URL via the following link (https://www.gulfspillrestoration.noaa.gov/).

1.1 Project Overview

The Lake Borgne Marsh Creation Project – Increment 1 is located in St. Bernard Parish, Louisiana between the southwestern shoreline of Lake Borgne and Mississippi River Gulf Outlet

(MRGO) (Figure 1). The Lake Borgne Project will restore approximately 2,935 acres of degraded intertidal marsh through strategic placement of dredge material (Figure 1). The project is currently in the engineering and design phase and is examining various alternatives. The elevation will be determined in the Final Design Report which has not been developed as of this version of the MAM Plan. However, it is anticipated that the elevation of the marsh platform will be approximately +1.3 feet (NAVD88). Sediment for the marsh will be dredged from the southern portion of Lake Borgne. Upon completion of the project, suitable native herbaceous vegetation is expected to naturally become established within the first few years. However, vegetative plantings on the marsh platform may occur if natural succession does not occur as anticipated (see Section 5 on corrective actions).

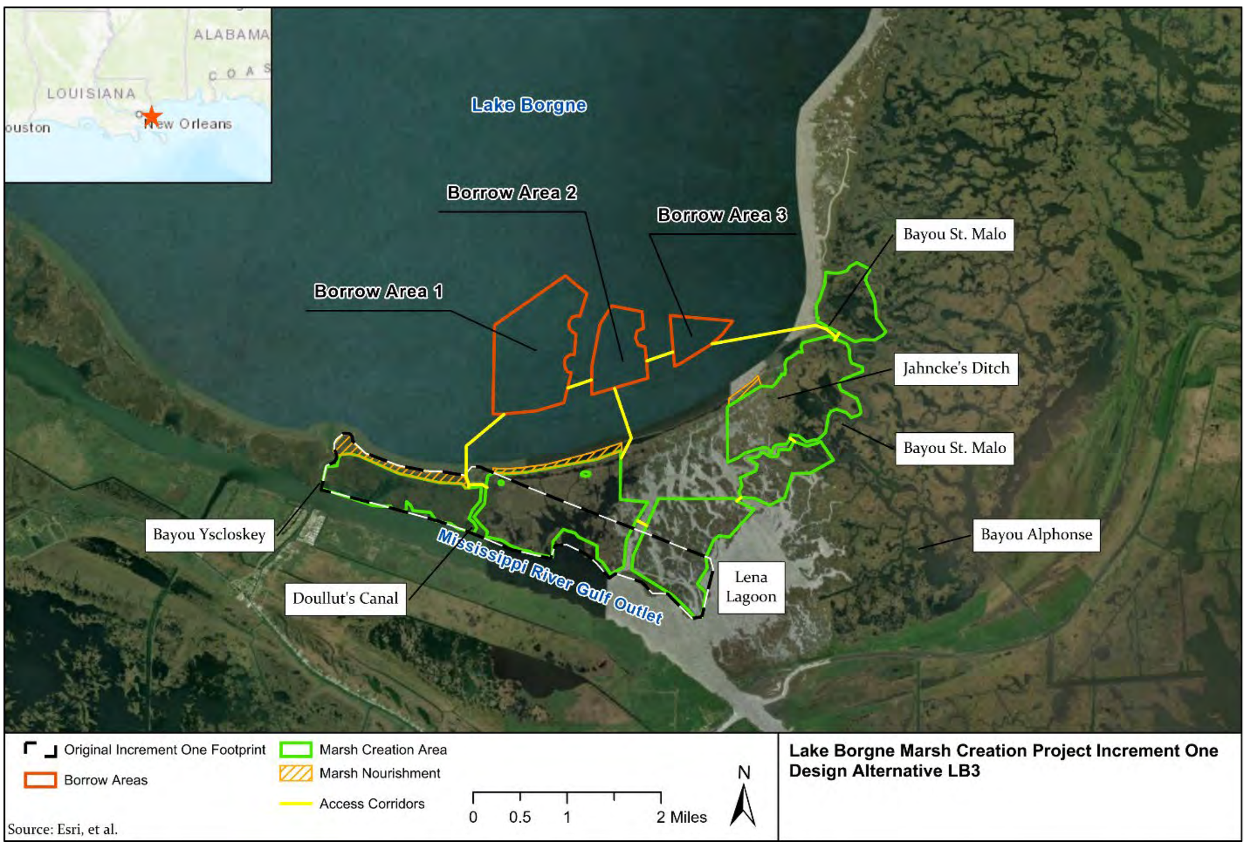

Figure 1. Lake Borgne Project Marsh Creation

The Lake Borgne Project is being implemented as restoration for the *Deepwater Horizon* oil spill Natural Resource Damage Assessment (NRDA), consistent with the PDARP/PEIS (Deepwater Horizon Natural Resource Damage Assessment Trustees. 2016). Per the PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Restore and Conserve Habitat
- **Restoration Type:** Wetlands, Coastal, and Nearshore Habitats
- **Restoration Approach:** Create, Restore, and Enhance Coastal Wetlands

- **Restoration Technique:** Create or enhance coastal wetlands through placement of dredged material
- **Trustee Implementation Group:** LA TIG
- **Restoration Plan:** Louisiana Trustee Implementation Group Final Restoration Plan #1.2: Barataria Basin Ridge and Marsh Creation Project Spanish Pass Increment and Lake Borgne Marsh Creation Project Increment One

The implementing state trustee is the Coastal Protection and Restoration Authority (CPRA) of Louisiana. The implementing federal trustee is the United States Department of Interior, represented by the U. S. Fish and Wildlife Service (USFWS).

1.2 Restoration Type Goals and Project Restoration Objectives

The goal for the Project is to create and restore wetlands, coastal and nearshore habitats in the Louisiana Restoration area (LA TIG, 2017) specifically along the Lake Borgne shoreline. This area has been degraded due to eustatic sea level rise, high subsidence rates, reduced sediment supply, and wave action. In restoring these coastal habitats, the Trustees envision that the Project will compensate, in part, for wetlands, coastal and nearshore habitat losses associated with the spill.

1.2.1 Restoration Type Goals

As summarized in the PDARP/PEIS, Chapter 5, the restoration goals for injuries to coastal habitats are as follows:

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

1.2.2 Project Restoration Objectives

To help meet the restoration goals for injuries to coastal habitats, the project restoration objective is to create approximately 2,935 acres of new marsh habitat along the southern margin of Lake Borgne, which has been degraded due to sea-level rise, high subsidence rates, diminished sediment supply, and extreme storm events. The degree to which this restoration objective is met, as well as documentation of any collateral impacts from the project, will be evaluated via measurements of the following parameters:

- Parameter #1: Spatial Extent (acres) of marsh and ridge creation
- Parameter #2: Elevation of marsh and ridge areas
- Parameter #3: Vegetative Cover
- Parameter #4: Invasive Species Cover
- Parameter #5: Gulf Sturgeon Presence
- Parameter #6: Water Quality
- Parameter #7: Benthic Invertebrate Recolonization
- Parameter #8: Borrow Area – Infilling Rate

These parameters will be monitored according to the monitoring schedule summarized in Section 2.

Throughout the design process, project team members, including the CPRA, the Louisiana Department of Wildlife and Fisheries (LDWF), the National Oceanic and Atmospheric Administration (NOAA), 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 Lake Borgne Project is located adjacent to the MRGO approximately 30 miles east-southeast of New Orleans, in St. Bernard Parish, Louisiana. Historically, the marshes in this part of Louisiana received freshwater, nutrients, and sediments from the Mississippi River through distributary channels and overbank flooding events. However, the Mississippi River levees have isolated these wetlands from these replenishing sediments; combined with coastal erosion and sea level rise, these factors have caused significant degradation of these marshes. Marsh creation projects like the one proposed here could help to build and maintain these habitats through time. Additional information about the conceptual setting for the Lake Borgne project is summarized in Section 2.2.2 of the *Louisiana Trustee Implementation Group Final Restoration Plan #1* (LA TIG 2017) and is incorporated here by reference.

1.3.1 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR § 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., sediment compaction or vegetation success). For the Lake Borgne marsh creation project, the uncertainties summarized in Table 1 could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. Sections 2 through 3 summarize project monitoring data and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees utilized a variety of sources, including but not limited to PDARP/PEIS Restoration Type MAM sections (Deepwater Horizon Natural Resource Damage Assessment Trustees. 2016), *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0* (*Deepwater Horizon* (DWH) Natural Resource Damage Assessment Trustees. 2017), 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 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision-Making
1	Sea level rise, subsidence, sediment compaction	Increased flooding of the marsh platform would reduce the growth and cover of herbaceous plant species and increase the coverage of submerged aquatic species or increase the open-water area.
2	Success of vegetation establishment/plantings	Lack of vegetation establishment/planting success would limit or delay the creation of the desired habitat.
3	Herbivory	Young tender plants, either through natural succession or vegetative plantings, are desired by some species as a source of food. Herbivory may cause the increase of planting efforts by requiring devices to reduce plant consumption. Also, would delay the establishment of vegetation and habitat creation.

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision-Making
4	Impact on Gulf Sturgeon	Dredging will take place in Critical Habitat for Gulf Sturgeon. It is not known whether Gulf Sturgeon use these areas for foraging for benthic prey. Furthermore, it is not known whether borrow areas will alter water quality conditions relative to undisturbed areas or the long-term impacts to substrate composition and/or benthic invertebrates.

2 Project Monitoring

The MAM Plan was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed, for the first 5 years after the project's construction. The data collected during this 5-year period will also be used to predict the project's performance during the remaining years of the project's design life (20 years total). This section summarizes the project monitoring parameters that will be used to evaluate performance through time. For each of the identified monitoring parameters, information is provided as to its intended purpose (e.g., to monitor progress toward meeting the restoration objectives or to 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 Section 5, Project-Level Decisions).

The *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0* (Deepwater Horizon (DWH) Natural Resource Damage Assessment Trustees. 2017) recommends project-level monitoring be conducted at reference or control sites. The CPRA currently maintains a monitoring program that provides ecological data and research to support the planning, design, construction, evaluation, and adaptive management of Louisiana's wetland restoration projects (Folse et al. 2018). This Coast-wide Reference Monitoring System-Wetlands (CRMS) was developed and implemented to improve the monitoring program's effectiveness in evaluating individual restoration projects, as well as the combined effects of multiple projects by providing a network of reference sites where data are collected on a regular basis (Steyer et al. 2003). There are two CRMS-Wetland sites, CRMS4548 and CRMS4551, located within the project boundary and another two sites, CRMS3800 and CRMS4557, within 5 miles of the Project which have been collecting data since 2006. Vegetation, Rod-Surface Elevation Table (RSET), accretion, and hydrologic data from these CRMS sites will be used as reference sites to monitor project success.

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 to monitor project success:

- Parameter #1: Spatial Extent (acres) of marsh creation
  a) Purpose: To determine how many acres of marsh were created and the change in marsh area through time
  b) Method(s): Acquire and orthorectify high-resolution, near-vertical aerial imagery
  c) Timing, Frequency, and Duration: YR 0 - immediate post-construction/as-built will occur soon after construction activities conclude; Years (YRs) 3 and 5 post-construction - will occur during the Fall of the respective years
  d) Sample Size: Aerial imagery will be acquired for the entire project area and some surrounding areas
  e) Sites: Project area
- Parameter #2: Elevation of marsh
  a) Purpose: To determine that the average elevation is achieved per the design specifications for construction and to verify the elevation of the sediment is as expected per the design curves in the final design report at YRs 3 and 5 post-construction.
  b) Method: LiDAR and/or RTK topographic surveys
  c) Timing, Frequency, and Duration: Surveys will be conducted during construction (before and after sediment placement) and at YRs 0, 3, and 5 post-construction.
  d) Sample Size: Construction surveys will be conducted on transects spaced every 250 feet apart or as specified in the construction documents. YR 0 would utilize LiDAR and/or RTK as little to no vegetation is expected. YRs 3 and 5 transects will be spaced either 500, 750, or 1,000 feet apart.
  e) Sites: Throughout the project area
- Parameter #3: Vegetative Cover
  a) Purpose: To determine the vegetative percent cover in the marsh
  b) Method: Ocular estimates (Folse et al. 2018) using 2 meter by 2 meter plots randomly placed along transects through the project area. Includes cover and species present.
  c) Timing, Frequency, and Duration: YR 1 – after first growing season (if sediment consolidation allows access), YRs 3 and 5 post-construction. Sampling will occur between mid-August and mid-November with the target being September/October.
  d) Sample Size: To be determined
  e) Sites: Project area; CRMS sites and restoration projects having similar habitats will be used as references

- Parameter #4: Invasive Species Cover
  a) Purpose: To determine invasive species percent cover
  b) Method: Ocular estimates (Folse et al. 2018) using 2 meter by 2 meter plots randomly placed along transects through the project area; same plots as Parameter #3: Vegetative Cover
  c) Timing, Frequency, and Duration: Same as Parameter #3: Vegetative Cover
  d) Sample Size: To be determined
  e) Sites: Project area; CRMS sites and restoration projects having similar habitats will be used as references
- Parameter #5: Gulf Sturgeon Telemetry
  a) Purpose: To determine whether acoustically tagged gulf sturgeon use the project borrow areas, both before and after dredging activities
  b) Method: Detect the presence of acoustically tagged sturgeon in the vicinity of the project area, and specifically within the borrow area footprints. An array of stationary acoustic receivers would provide continuous monitoring of the dredge areas by logging the presence of sturgeon that have been tagged during a variety of previous and ongoing studies.
  c) Timing, Frequency, and Duration: Continuous monitoring of deployed receivers for approximately two years (up to one-year pre-construction and up to one-year post-construction)
  d) Sample Size: Approximately 20 acoustic receivers for 2 years (number of receivers will be dependent on field-verified detection range).
  e) Sites: The majority of the acoustic receivers would be placed in a gate array encircling the project borrow areas, with the remainder providing discrete monitoring within the targeted dredge locations.
- Parameter #6: Water Quality
  a) Purpose: To measure water quality at various depths within and surrounding the borrow areas
  b) Method: Water quality multi-probe sonde will be deployed from a boat to measure turbidity, temperature, pH, specific conductance, salinity, and dissolved oxygen at multiple depths and locations.
  c) Timing, Frequency, and Duration: Discrete samples will be collected monthly for up to one year prior to dredging and at least one year following dredging completion. Sampling may occur biweekly during summer if stratification or hypoxia is detected.
  d) Sample Size: Approximately 30 locations (3-4 depths at each location)
  e) Sites: Within and adjacent to the three dredge borrow areas
- Parameter#7: Benthic Invertebrate Recolonization

a) Purpose: To evaluate pre- and post-dredging macroinvertebrate density and community composition to estimate the rate of post-dredging recolonization of the benthic community in relation to water quality and substrate composition.
b) Method: Collect surficial benthic grab samples for biologic and substrate compositional analysis. Quantify component grain size classes of substrate samples using graduated sieves to separate material into grain size classes representative of silt/clay (< 0.59 mm), sand (0.6 -1 mm), gravel (> 1 and < 16 mm), and larger (> 16 mm). Calculate organic content (loss on ignition). Conduct taxonomic identification and enumeration of benthic macroinvertebrates. Collect water quality data (dissolved oxygen, salinity, turbidity, temperature) associated with each benthic sample location.
c) Timing, Frequency, and Duration: Samples would be collected prior to dredging as a representative baseline, and repeated in years 1, 3, and 5 post-dredging, depending on the presence of Gulf sturgeon in the area and any changes in community structure identified due to dredging.
d) Sample Size: Samples will be collected in quadruplicate, for each of the three borrow areas and a non-disturbed control site, during each sampling period to characterize benthic substrate and macroinvertebrate fauna (up to 40 samples per period with up to 120 samples total).
e) Sites: During each of the four sampling periods, quadruplicate samples will be collected from within each of the three planned dredge location footprints, as well as from adjacent control areas that will remain undisturbed by the project.

- Parameter #8: Borrow Area – Infilling Rate
  a) Purpose: To determine the rate of sediment infilling of the borrow area after dredging.
  b) Method: Single beam bathymetry survey
  c) Timing, Frequency, and Duration: YRs 1, 3, and 5 post-construction
  d) Sample Size: The survey will be completed on a 500 foot by 1,000 foot grid.
  e) Sites: The borrow area plus transects extended beyond the borrow area for reference

3 Adaptive Management

Monitoring information collected at the project-level can be used to adaptively manage the project to improve restoration outcomes. 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 2).

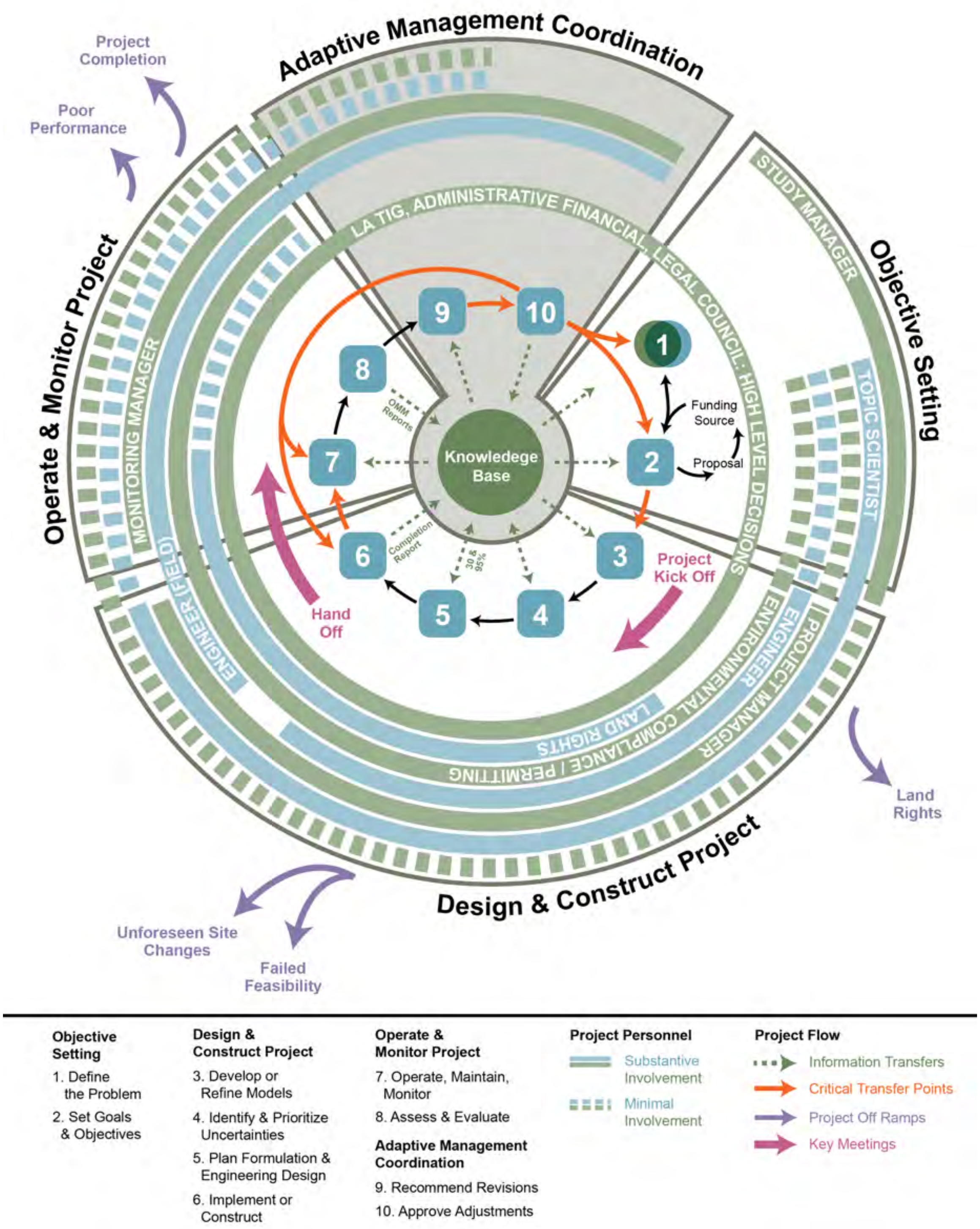

Figure 2. LA TIG Adaptive Management Cycle (Source: The Water Institute of the Gulf. 2019)

1. Goal-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 Lake Borgne Project, 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.

2. 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 progresses to more advanced phases, the design may be modified as needed to incorporate any new information that could affect the preliminary design.
3. 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.
4. 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

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. Reports, presentations, and/or lesson learned meetings are potential avenues of transferring information to the LATIG and other agency personnel about project performance.

The results of these analyses would be used to answer the following questions and would be included within the reports described in Section 8:

- 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 are grouped below by monitoring parameters:

Parameter #1: Spatial Extent (acres) of marsh creation

Analysis: Aerial imagery, elevation, and/or vegetation data sets collected for the project will be used to determine habitat evolution and acreages. Aerial imagery will be analyzed for land – water composition. Elevation data and vegetation data will be used to determine habitat types and species composition of those habitats.

Parameter #2: Elevation of marsh

Analysis: The project's Final Design Report will establish the desired elevation of each feature in order for appropriate herbaceous species to colonize and create marsh habitat. Data will be analyzed for the average elevation in each habitat. Other mapping products such as triangulated irregular network (TIN) models could be generated in Geographical Information System (GIS) software packages along with digital elevation models (DEM) to show the elevation across the project area. Over time, differences amongst the individual models would show elevation changes.

The constructed target elevations for marsh will be determined using the methodology(ies) in CPRA's Marsh Creation Design Guidelines (2017). These elevations use various data sources such as water elevation, sea-level rise, and subsidence. At YRs 3 and 5, data will be analyzed using the same methods and updated data (current water elevations and habitat elevations) to determine if the habitat is within the optimal marsh inundation ranges for habitat development. The same water level gauges used in the Final Design Report will be used for YRs 3 and 5, if still active.

The average elevation will be determined using YRs 3 and 5 data sets to determine if these elevations are as predicted in the project settlement curves that will be published in the Final Design Report. However, the elevation of marsh is not a performance criterion at years 3 and 5.

Parameter #3: Vegetative Cover

Analysis: General descriptive statistical analyses may include, but are not limited to, averages/means of the overall total cover by herbaceous species and/or shrubs (marsh); percent cover of species; and/or average height of dominant species. After each data collection effort, all collected and analyzed data will be evaluated to determine existing habitat type. After multiple data collection efforts, comparisons between each time period will be assessed to determine the evolution of the habitat. Data from CRMS sites in the vicinity, within the basin, and coast-wide of similar habitats may be analyzed for comparative performance purposes.

Parameter #4: Invasive Species Cover

Analysis: Data sets will be examined for invasive species. If invasive species are identified within the data set, the average percent cover will be calculated.

Parameter #5: Gulf Sturgeon Telemetry

Analysis: The data will be evaluated to determine utilization of this area of Lake Borgne by acoustically tagged Gulf sturgeon and to evaluate any discernable changes following dredging.

- Are tagged Gulf sturgeon present in the targeted dredge areas before dredging begins? If so, what is the frequency and duration of their use?
- Are tagged Gulf sturgeon present in the dredge locations or surrounding areas after dredging occurs? If so, what is the frequency and duration of their use?
- If tagged Gulf sturgeon are observed in the project area vicinity, do they avoid the borrow locations? If so, are there corresponding differences in the environmental parameters inside and outside of the borrow areas?

Parameter #6: Water Quality

Analysis: The data will be evaluated to understand the nature of change in suitability of the aquatic environment for Gulf sturgeon and the degree to which dredging depth might contribute to differences in water quality which in turn may affect habitat suitability and benthic prey. This parameter will be collected pre-construction and will continue to 5 years post-construction if telemetry data indicate presence of sturgeon in the project area.

Water quality parameters at various depths will be evaluated to address the following questions:

- Is the water column stratified in any of the borrow areas when it is not stratified in the surrounding areas?

- Is water quality within the borrow areas similar to the water quality in the surrounding undisturbed areas?
- Is there discernible difference in water quality among the three borrow areas? If so, is there a correlation with water depth of other the physical features or configuration of the borrow areas?

Parameter #7 Benthic Macroinvertebrate Recolonization

Analysis: Benthic macroinvetebrate communities and substrate grain size and organic content will be sampled and assessed prior to dredging activities to serve as a representative baseline. Over time, these sampling efforts will be repeated at 1, 3, and 5 years post-dredging to estimate the rate and characteristics of benthic community recovery. Comparative substrate composition can also be used to determine potential correlation between macroinvertebrate recolonization and physical shifts in substrate over time within the dredge locations. This parameter will be collected pre-construction and will continue post-construction if telemetry data indicate presence of sturgeon in the project area or if reference and borrow areas show differences.

Parameter #8: Borrow Area – Infilling Rate

Analysis: Single-beam bathymetry data will be analyzed to determine the rate of sediment infilling by averaging the elevation at the time of survey and comparing to previous survey average elevation. The time between surveys will allow a rate to be calculated. Other mapping products such as TIN models could be generated in GIS software packages along with DEMs to show the elevation across the project area. Over time, differences amongst the individual models would show elevation changes as well as volumetric changes.

5 Project-Level Decisions: Performance Criteria and Potential Correction Actions

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

Monitoring Parameter	Final Performance Criteria Used to Determine Project Success	Potential Corrective Actions
Spatial Extent	There will be no more than the equivalent of 0.62% annual land loss rate between year 0 and 5 post-construction. (see note 1 after this table)	Planting of appropriate species
Elevation	The target elevations stated in the Final Design Report at the time of construction. (see note 2 after this table)	Addition or regrading of sediments
Vegetative Cover	Live vegetative cover is equal to or greater than 65% at Year 5	Planting of herbaceous species
Invasive Species Cover	Average live vegetative cover of invasive species is not greater than 25% at Year 5.	Mechanical removal or herbicide application
Gulf Sturgeon Telemetry	Successfully deploy an acoustic receiver array prior to and after dredging activities to detect the presence of Gulf sturgeon tagged with acoustic transmitters	If relatively high numbers of detections occur in the project area, appropriately refocus the scope of monitoring and analysis.
Water Quality [3]	The successful monitoring of water quality parameters prior to and after dredging activities, and identification of differential trends by dredge depths.	Adaptively manage future projects in the area to take into account information gleaned from dredge depths on water quality

Monitoring Parameter	Final Performance Criteria Used to Determine Project Success	Potential Corrective Actions
Benthic Macroinvertebrate Recolonization (see note 3 after this table)	Collection of surficial grab samples for the analysis of substrate grain size and benthic invertebrate communities in the project area and quantify recolonization rates	Extend sampling duration should areas remain un-colonized after year 5
Borrow Area – Infilling Rate	Collection of single beam bathymetry data within and around the borrow area	No corrective action

Note 1: The land loss rate of 0.62% was determined from the 23,900 acres of marsh that existed in 1932 and 16,600 acres of marsh that existed in 1990, i.e., lost 7,300 acres in 58 years or 125.86 acres/year. Source: Appendix C, Coast 2050: Toward a Sustainable Coastal Louisiana.
Note 2: The project is currently gathering data to make the final determination. The Final Design Report is scheduled for late 2019.
Note 3: As needed, depending on results of Gulf Sturgeon telemetry results and/or results of each period.

6 Monitoring Schedule

The project monitoring schedule (Table 3) is separated by monitoring activities. Pre-execution monitoring will occur before any project construction activities occur, if applicable. Execution of monitoring will occur when the construction activities have been deemed complete. Performance monitoring will occur in the years following construction (YRs 0-5).

Table 3. Monitoring Schedule

Monitoring Parameters	Execution Monitoring Time (initial)	Post-Execution Monitoring Time (ongoing)				
	As-built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5
Vegetation Survey	n/a	**X**	n/a	**X**	n/a	**X**
Elevation Survey	**X**	n/a	n/a	**X**	n/a	**X**
Aerial Imagery Acquisition	**X**	**O**	**O**	**X**	**O**	**X**
Sturgeon Presence	n/a	**X**	n/a	n/a	n/a	n/a
Water Quality	n/a	**X**	n/a	**O**	n/a	**O**
Benthic Macroinvertebrate Recolonization	n/a	**X**	n/a	**O**	n/a	**O**
Borrow Area – Infilling Rate	n/a	**X**	n/a	**X**	n/a	**X**

Note: “x” in bold indicates required data acquisitions; “o” in bold indicates optional/as needed; “n/a” indicates not applicable.

7 Data Management

7.1 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 will 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).

7.2 Data Review and Clearance

Data will be reviewed for QA/QC in accordance with the *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0* (*Deepwater Horizon* (DWH) Natural Resource Damage Assessment Trustees. 2017), 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.

7.3 Data Storage and Accessibility

Once data have been cleared, they will be submitted to 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.

7.4 Data Sharing

Data will be made publicly available in accordance with the Federal Open Data Policy through the DIVER Explorer Interface within 1 year of when the data collection occurred. Also, data will be made available through the Coastal Protection and Restoration Authority's Coastal Information Management System (CIMS) database (https://cims.coastal.louisiana.gov/default.aspx). Larger datasets such as LiDAR will be made available through portals appropriate for handling the associated file sizes.

8 Reporting

Based on the project monitoring schedule (Section 4), associated reporting will be submitted in post-construction YRs 2, 4, and 6 which represents one year after data collection efforts in YRs 1, 3, and 5. Each of these reports will primarily focus on answering the questions presented in Section 4, Evaluation. The YR 1 and 3 reports will be more progress related reports, whereas the YR 5 report will be comprehensive in nature and answer whether or not the project met each of the performance criteria (PC). If the project did not meet a PC, then an explanation will be provided. For each report, if corrective actions are required then a corrective action plan would be generated, and variables would continue to be monitored.

The reports will follow the template recommended in the *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0* (*Deepwater Horizon* (DWH) Natural Resource Damage Assessment Trustees. 2017), Appendix D. MAM reports and lessons learned from the monitoring activities will be disseminated to the LA TIG through relevant portals, and information will be more broadly disseminated at conferences to reach a larger audience.

9 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. CPRA 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 review for implementation. The implementing Trustees' roles include:

- Data collection
- Data analysis
- Report composition
- Ensuring corrective action activities are performed, if necessary

- Providing project progress information to the LA TIG

10 Monitoring and Adaptive Management Budget

The overall budget for the project monitoring and adaptive management plan is $2,734,200 and covers the activities identified in Table 4 as well as data analysis, report composition, and project management. This budget may be reduced if telemetry results indicate that dissolved oxygen and/or benthic invertebrate sampling is no longer needed post-construction.

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Appendix G

Tables Supporting NEPA Analysis

Table G-1. Gulf Council EFH Designations and Depth Preferences – Eco-Region 4 – Spanish Pass.

EFH Designations and Depth Preferences by Life Stage in meters (m)

NOTE: Gulf Council EFH designations extend to 182 m (100 fathoms).

Species Common Name	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
cobia	ND	11-53	11-53	5-300	6-9	1-70	1-70
king mackerel	35-180	35-180	ND	9 max	ND	35 min	35-180
red drum	ND	ND	ND	0-3	0-5	1-70	40-70
almaco jack	NE	NE	NE	15-160	15-160	15-160	NE
gray snapper	NE	NE	NE	NE	NE	0-180	0-180
gray triggerfish	10-100	ND	ND	ND	10-100	10-100	10-100
greater amberjack	1-360	1-360	1-360	1-360	1-360	1-360	1-360
lane snapper	4-132	4-132	ND	0-20	0-20	4-132	4-132
red snapper	18-37	18-37	18-37	17-183	20-46	7-146	18-37
brown shrimp	18-110	0-82	NA	0-18	NA	14-110	18-110
white shrimp	9-34	1-82	NA	1-30	NA	9-27	9-34

NOTES: ND = no data; NA = post larvae and late juvenile life stages not utilized for Shrimp; eggs, post larvae, and spawning adult life stages not utilized for spiny lobster; NE = EFH not designated; presence/absence or density threshold not met in this eco-region for this life stage.

Table G-2. Estuarine Habitats – Gulf Council Managed Species – Eco-Region 4 – Spanish Pass.

(Note: "yes" or "no" is indicates if habitat type is designated as EFH for species' life stage. If "yes" is indicated, bold font is used.)

Habitat Type	Species Common Name	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
Estuarine Emergent Marsh	red drum	no	no	**yes**	**yes**	no	**yes**	no
Estuarine Emergent Marsh	gray snapper	no	no	no	no	no	**yes**	no
Estuarine Emergent Marsh	brown shrimp	no	no	no	**yes**	no	no	no
Estuarine Emergent Marsh	white shrimp	no	no	no	**yes**	no	no	no
Mangrove	gray triggerfish	no	no	no	**yes**	no	no	no
Mangrove	lane snapper	no	no	no	**yes**	**yes**	no	no
Estuarine Submerged Aquatic Vegetation	red drum	no	**yes**	**yes**	no	**yes**	**yes**	no
Estuarine Submerged Aquatic Vegetation	lane snapper	no	no	**yes**	**yes**	**yes**	no	no
Estuarine Submerged Aquatic Vegetation	brown shrimp	no	no	no	**yes**	no	no	no

Habitat Type	Species Common Name	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
Estuarine Oyster Reef	brown shrimp	no	no	no	**yes**	no	no	no
Estuarine Sand and Shell Bottom	red drum	no	no	**yes**	no	no	**yes**	no
Estuarine Sand and Shell Bottom	gray snapper	no	no	no	no	no	**yes**	no
Estuarine Sand and Shell Bottom	lane snapper	no	no	no	**yes**	**yes**	no	no
Estuarine Sand and Shell Bottom	brown shrimp	no	no	no	**yes**	no	no	no
Estuarine Mud/Soft Bottom	red drum	no	**yes**	**yes**	**yes**	no	**yes**	no
Estuarine Mud/Soft Bottom	gray snapper	no	no	no	no	no	**yes**	no
Estuarine Mud/Soft Bottom	lane snapper	no	no	no	**yes**	**yes**	no	no
Estuarine Mud/Soft Bottom	brown shrimp	no	no	no	**yes**	no	no	no
Estuarine Mud/Soft Bottom	white shrimp	no	no	no	**yes**	no	no	no

Table G-3. Nearshore Habitats – Gulf Council Managed Species – Eco-Region 4 – Spanish Pass.

(Note: “yes” or “no” is indicates if habitat type is designated as EFH for species’ life stage. If “yes” is indicated, bold font is used.)

Habitat Type	Species Common Name	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
Nearshore Submerged Aquatic Vegetation	lane snapper	no	no	**yes**	**yes**	**yes**	no	no
Nearshore Sand/Shell Bottom	red drum	no	no	no	no	**yes**	**yes**	no
Nearshore Sand/Shell Bottom	gray snapper	no	no	no	no	no	**yes**	no
Nearshore Sand/Shell Bottom	gray triggerfish	no	no	no	no	no	**yes**	**yes**
Nearshore Sand/Shell Bottom	lane snapper	no	no	no	**yes**	**yes**	**yes**	no
Nearshore Sand/Shell Bottom	red snapper	no	no	no	no	no	**yes**	no
Nearshore Sand/Shell Bottom	brown shrimp	no	no	no	no	no	**yes**	no
Nearshore Sand/Shell Bottom	white shrimp	**yes**	no	no	no	no	no	no
Nearshore Mud/Soft Bottom	gray snapper	no	no	no	no	no	**yes**	no

Habitat Type	Species Common Name	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
Nearshore Mud/Soft Bottom	lane snapper	no	no	no	**yes**	**yes**	no	no
Nearshore Mud/Soft Bottom	red snapper	no	no	no	**yes**	no	no	no
Nearshore Mud/Soft Bottom	brown shrimp	no	no	no	no	no	**yes**	no
Nearshore Mud/Soft Bottom	white shrimp	**yes**	no	no	no	no	**yes**	**yes**
Nearshore Shoal/Banks	gray snapper	no	no	no	No	no	no	**yes**
Nearshore Shoal/Banks	lane snapper	no	no	no	No	no	**yes**	no
Nearshore Pelagic	cobia	**yes**	no	**yes**	**Yes**	**yes**	**yes**	**yes**
Nearshore Pelagic	king mackerel	no	no	no	**Yes**	**yes**	no	no
Nearshore Pelagic	red drum	**yes**	no	no	No	no	**yes**	no
Nearshore Pelagic	greater amberjack	no	no	no	No	no	**yes**	no
Nearshore Pelagic	red snapper	no	**yes**	no	No	no	no	no
Nearshore Pelagic	white shrimp	no	**yes**	no	No	no	no	no
Nearshore Drift Algae (*Sargassum*)	almaco jack	no	no	no	**Yes**	**yes**	no	no
Nearshore Drift Algae (*Sargassum*)	gray triggerfish	no	**yes**	**yes**	**Yes**	**yes**	no	no
Nearshore Drift Algae (*Sargassum*)	greater amberjack	no	no	no	**Yes**	**yes**	no	no

Table G-4. Highly Migratory Species EFH Designations – State Waters of Eco-Region 4 – Spanish Pass.

Species Common Name	Life Stage	EFH State Waters of Eco-Region 4
scalloped hammerhead shark	Neonate	Galveston Bay; Vermilion Bay to West Bay; all nearshore waters to 30 fathoms
blacktip shark	Neonate and Juvenile	Estuarine waters of Galveston, Terrebonne, and Timbalier Bays; all nearshore and offshore waters
blacktip shark	Adult	Estuarine waters of Vermilion, Atchafalaya, Terrebonne, and Timbalier Bays; all nearshore and offshore waters
bull shark	Neonate	All estuarine waters; nearshore waters Freeport to mouth of Sabine Lake; nearshore waters off west Cameron Parrish
bull shark	Juvenile	All estuarine waters; nearshore waters Freeport to mouth of Sabine Lake; nearshore waters off west Cameron Parrish; Terrebonne Bay to Mississippi River delta
Atlantic sharpnose shark	Neonate	All nearshore and offshore waters Freeport to the mouth of the Mississippi, Christmas Bay, Galveston Bay (including West, Trinity and East Bays), Vermilion, West Cote Blanche, Atchafalaya, lower Terrebonne and Timbalier Bays, and Barataria Bay

Species Common Name	Life Stage	EFH State Waters of Eco-Region 4
Atlantic sharpnose shark	Juvenile	All nearshore and offshore waters Freeport to the mouth of the Mississippi, Christmas Bay, West Bay, and lower Terrebonne and Timbalier Bays
Atlantic sharpnose shark	Adult	All nearshore and offshore waters Freeport to the mouth of the Mississippi, Christmas Bay, Galveston Bay (including West, Trinity and East Bays), lower Terrebonne and Timbalier Bays, and Barataria Bay
blacknose shark	Adult	Nearshore waters off Galveston Island and Mississippi River birdfoot delta
finetooth shark	Juvenile and Adult	Estuarine and nearshore waters east of Terrebonne Bay
silky shark	ALL	Mississippi River birdfoot delta
Spinner Shark	Neonate	Galveston Bay (including East, West and Trinity Bays) and nearshore waters off Brazoria, Galveston, and Chambers Counties; Terrebonne Bay and estuarine and nearshore waters to Grand Isle
Spinner Shark	Juvenile	Galveston Bay (including East, West and Trinity Bays) all nearshore waters (ex. off mouth of Mermentau River and between Vermilion and Atchafalaya Bays); Terrebonne and Barataria Bays and the Mississippi birdfoot delta
Spinner Shark	Adult	Mississippi River birdfoot delta

Table G-5. Bird Species Observed Near and Expected to Use the Lake Borgne Project Area.

Common Name	Scientific Name	Common Name	Scientific Name
American coot	*Fulica Americana*	least bittern	*Ixobrychus exilis*
American kestrel	*Falco sparverius*	least tern*	*Sternula antillarum*
American robin	*Turdus migratorius*	lesser scaup	*Aythya affinis*
American white pelican	*Pelecanus erythrorhynchos*	little blue heron	*Egretta caerulea*
Anhinga	*Anhinga anhinga*	loggerhead shrike	*Lanius ludovicianus*
barn swallow	*Hirundo rustica*	magnificent frigatebird*	*Fregata magnificens*
belted kingfisher	*Megaceryle alcyon*	marsh wren	*Cistothorus palustris*
black skimmer*	*Rynchops niger*	Mississippi kite	*Ictinia mississippiensis*
black vulture	*Coragyps atratus*	mottled duck	*Anas fulvigula*
black-bellied plover	*Pluvialis squatarola*	mourning dove	*Zenaida macroura*
black-bellied whistling duck	*Dendrocygna autumnalis*	Nelson's sparrow*	*Ammospiza nelsoni*
black-necked stilt	*Himantopus mexicanus*	northern cardinal	*Cardinalis cardinalis*
blue-gray gnatcatcher	*Polioptila caerulea*	northern flicker	*Colaptes auratus*
blue jay	*Cyanocitta cristata*	northern harrier	*Circus hudsonius*
boat-tailed grackle	*Quiscalus major*	northern mockingbird	*Mimus polyglottos*
blue-winged teal	*Spatula discors*	northern parula	*Setophaga americana*
bronzed cowbird	*Molothrus aeneus*	northern shoveler	*Spatula clypeata*
brown-headed cowbird	*Molothrus ater*	orange-crowned warbler	*Oreothlypis celata*
brown pelican*	*Pelecanus occidentalis*	orchard oriole	*Icterus spurius*
bufflehead	*Bucephala albeola*	osprey	*Pandion haliaetus*
Carolina chickadee	*Poecile carolinensis*	painted bunting	*Passerina ciris*
Carolina wren	*Thryothorus ludovicianus*	peregrine falcon	*Falco peregrinus*
Caspian tern	*Hydroprogne caspia*	purple martin	*Progne subis*
cedar waxwing	*Bombycilla cedrorum*	red-breasted merganser*	*Mergus serrator*
chimney swift	*Chaetura pelagica*	reddish egret*	*Egretta rufescens*
clapper rail*	*Rallus crepitans*	redhead	*Aythya americana*
common grackle	*Quiscalus quiscula*	red-shouldered hawk	*Buteo lineatus*
common loon*	*Gavia immer*	red-tailed hawk	*Buteo jamaicensis*

Common Name	Scientific Name	Common Name	Scientific Name
common nighthawk	*Chordeiles minor*	red-winged blackbird	*Agelaius phoeniceus*
Cooper's hawk	*Accipiter cooperii*	ring-billed gull*	*Larus delawarensis*
double-crested cormorant*	*Phalacrocorax auratus*	royal tern*	*Thalasseus maximus*
downy woodpecker	*Dryobates pubescens*	ruby-crowned kinglet	*Regulus calendula*
dunlin*	*Calidris alpine*	sandwich tern	*Thalasseus sandvicensis*
eastern kingbird	*Tyrannus tyrannus*	Savannah sparrow	*Passerculus sandwichensis*
eastern phoebe	*Sayornis phoebe*	seaside sparrow*	*Ammospiza maritima*
eastern towhee	*Pipilo erythrophthalmus*	snowy egret	*Egretta thula*
Eurasian collared-dove	*Streptopelia decaocto*	spotted sandpiper	*Actitis macularius*
European starling	*Sturnus vulgaris*	swallow-tailed kite*	*Elanoides forficatus*
Forster's tern	*Sterna forsteri*	swamp sparrow	*Melospiza georgiana*
Gadwall	*Mareca Strepera*	tree swallow	*Tachycineta bicolor*
glossy/white-faced ibis	*Plegadis* sp.	tricolored heron	*Egretta tricolor*
gray catbird	*Dumetella carolinensis*	turkey vulture	*Cathartes aura*
great blue heron	*Ardea Herodias*	western sandpiper	*Calidris mauri*
great crested flycatcher	*Myiarchus crinitus*	white-eyed vireo	*Vireo griseus*
great egret	*Ardea alba*	white ibis	*Eudocimus albus*
great horned owl	*Bubo virginianus*	white-throated sparrow	*Zonotrichia albicollis*
green heron	*Butorides virescens*	willet*	*Tringa semipalmata*
hairy woodpecker	*Dryobates villosus*	Wilson's snipe	*Gallinago delicata*
herring gull*	*Larus argentatus*	yellow-bellied sapsucker	*Sphyrapicus varius*
house sparrow	*Passer domesticus*	yellow-billed cuckoo	*Coccyzus americanus*
Killdeer	*Charadrius vociferous*	yellow-crowned night-heron	*Nyctanassa violacea*
laughing gull	*Leucophaeus atricilla*	yellow-rumped warbler	*Setophaga coronata*

Notes: Observations as documented in the Cornell Laboratory of Ornithology eBird Database (2018).
*USFWS Birds of Conservation Concern species (2008)

Table G-6. Gulf Council EFH Designations and Depth Preferences – Eco-Region 3 – Lake Borgne.

EFH Designations and Depth Preferences by Life Stage in meters (m)
NOTE: Gulf Council EFH designations extend to 182 m (100 fathoms).

Species Common Name	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
Spanish mackerel	50 max	9-84	ND	ND	50 max	3-75	50 max
red drum	ND	ND	ND	0-3	0-5	1-70	40-70
gray snapper	NE	NE	NE	NE	NE	0-180	0-180
lane snapper	4-132	4-132	ND	0-20	0-20	4-132	4-132
brown shrimp	18-110	0-82	NA	0-18	NA	14-110	18-110
white shrimp	9-34	1-82	NA	1-30	NA	9-27	9-34

NOTES: ND = no data; NA = post larvae and late juvenile life stages not utilized for shrimp; eggs, post larvae, and spawning adult life stages not utilized for spiny lobster; NE = EFH not designated; presence/absence or density threshold not met in this eco-region for this life stage.

Table G-7. Estuarine Habitats – Gulf Council Managed Species – Eco-Region 3 – Lake Borgne.

(Note: "yes" or "no" is indicates if habitat type is designated as EFH for species' life stage. If "yes" is indicated, bold font is used.)

Habitat Type	Species Common Name	Eggs	Larvae	Post Larvae	Early Juvenile	Late Juvenile	Adult	Spawning Adult
Estuarine Emergent Marsh	red drum	no	no	**yes**	**yes**	no	**yes**	no
Estuarine Emergent Marsh	gray snapper	no	no	no	no	no	**yes**	no
Estuarine Emergent Marsh	brown shrimp	no	no	no	**yes**	no	no	no
Estuarine Emergent Marsh	white shrimp	no	no	no	**yes**	no	no	no
Mangrove	lane snapper	no	no	no	**yes**	**yes**	no	no
Estuarine Submerged Aquatic Vegetation	red drum	no	**yes**	**yes**	no	**yes**	**yes**	no
Estuarine Submerged Aquatic Vegetation	lane snapper	no	no	**yes**	**yes**	**yes**	no	no
Estuarine Submerged Aquatic Vegetation	brown shrimp	no	no	no	**yes**	no	no	no
Estuarine Submerged Aquatic Vegetation	Spanish mackerel	no	no	no	**yes**	**yes**	**yes**	no
Estuarine Oyster Reef	brown shrimp	no	no	no	**yes**	no	no	no
Estuarine Sand and Shell Bottom	red drum	no	no	**yes**	no	no	**yes**	no
Estuarine Sand and Shell Bottom	gray snapper	no	no	no	no	no	**yes**	no
Estuarine Sand and Shell Bottom	lane snapper	no	no	no	**yes**	**yes**	no	no
Estuarine Sand and Shell Bottom	brown shrimp	no	no	no	**yes**	no	no	no
Estuarine Mud/Soft Bottom	red drum	no	**yes**	**yes**	**yes**	no	**yes**	no
Estuarine Mud/Soft Bottom	gray snapper	no	no	no	no	no	**yes**	no
Estuarine Mud/Soft Bottom	lane snapper	no	no	no	**yes**	**yes**	no	no
Estuarine Mud/Soft Bottom	brown shrimp	no	no	no	**yes**	no	no	no
Estuarine Mud/Soft Bottom	white shrimp	no	no	no	**yes**	no	no	no

Table G-8. Highly Migratory Species EFH Designations – State Waters of Eco-Region 3 – Lake Borgne.

Species Common Name	Life Stage	EFH State Waters of Eco-Region 3
scalloped hammerhead shark	Neonate	All estuaries and nearshore waters
blacktip shark	Neonate and Juvenile	All estuarine, nearshore, and offshore waters (e.g., Lake Borgne)
blacktip shark	Adult	All estuarine, nearshore, and offshore waters (e.g., Lake Borgne, Mobile, Perdido, and Pensacola Bays)
bull shark	Neonate and Juvenile	Lake Borgne east to waters around Ship Island; Lower Mobile Bay and nearshore waters off Dauphin Island to Gulf Breeze
bull shark	Juvenile	All waters Mississippi River delta to Perdido Bay (e.g., portions of Chandeleur Sound and Lake Borgne)
Atlantic sharpnose shark	Neonate	Estuarine, nearshore, and offshore waters to 90 feet
Atlantic sharpnose shark	Juvenile	All nearshore and offshore waters to 90 feet; estuarine waters west of Mobile Bay (e.g., Lake Borgne)
Atlantic sharpnose shark	Adult	Estuarine waters west of Mobile Bay, nearshore and offshore waters to 200 feet
finetooth shark	Neonate	Nearshore waters west of Perdido Bay to Chandeleur Island; Mississippi Sound (e.g., Lake Borgne)
finetooth shark	Juvenile and Adult	Nearshore and offshore waters Pensacola Bay to Mississippi River birdfoot delta; Mississippi Sound and Chandeleur Sound (e.g., Lake Borgne)