6. Environmental Consequences and Compliance with Other Laws

What Is in This Chapter?

This chapter describes the predicted consequences, or effects, of implementing PDARP/PEIS restoration alternatives proposed in Chapter 5, Restoring Natural Resources, on the physical, biological, and socioeconomic environment. **Table 6.1-1** presents the location of required PEIS elements in this Draft PDARP/PEIS.

Table 6.1-1. Location of required PEIS elements in this document.

PEIS Required Elements (40 C.F.R § 1502.10, Recommended format)	**Location of Element in This Document**
Cover sheet	Cover sheet of this Draft PDARP/PEIS
Summary	Chapter 1, Introduction and Executive Summary
Table of Contents	Follows the cover sheet, cover, Letter to Reviewers, and Deepwater Horizon Oil Spill Natural Resource Trustees Resolution 15-2 for this Draft PDARP/PEIS
Purpose of and Need for Action	Chapter 5, Section 5.3.2, NEPA Statement of Purpose and Need
Alternatives Including Proposed Action	Chapter 5, Sections 5.5 through 5.8
Affected Environment	Chapter 3, Ecosystem Setting Chapter 4, Sections 4.4 through 4.10, particularly Introduction and importance of the resource and conclusions and key aspects of the injury for restoration planning Chapter 6, Section6.2, Approach to Affected Environment
Environmental Consequences	Chapter 6, Section 6.4, Evaluation of Environmental Consequences of Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative)
List of Repositories	Chapter 6, Section 6.18
List of Preparers	Chapter 6, Section 6.19
Appendices	Appendix 6.A, Appendix 6.B, Appendix 6.C, Appendix 6.D

This chapter is organized as follows:

- **Intent of the Chapter (Section 6.1):** What is the intent of this chapter?
- **Approach to Affected Environment (Section 6.2):** What is the pathway used to describe the affected environment, including a comprehensive ecological setting necessary to capture the comprehensive nature of the action, resources known to be injured by the oil spill, and resources potentially affected by the restoration approaches evaluated in this Draft PDARP/PEIS?
- **Approach to Evaluation of Environmental Consequences (Section 6.3):** What is the approach to considering environmental consequences, including definitions of impact determinations and their significance, using resource-specific criteria for the determinations?

- **Evaluation of Environmental Consequences of Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative) (Section 6.4):** What are the environmental consequences of the preferred alternative, evaluated by physical, biological, and socioeconomic resources, and how are impacts on the physical, biological, and socioeconomic environments evaluated for each of the 39 restoration approaches identified in Chapter 5?
- **Evaluation of Direct and Indirect Environmental Consequences** for Other Alternatives **(Section 6.5):** What is the range of environmental consequences associated with these alternatives and how do the alternatives compare?
- **Cumulative Impacts (Section 6.6):** What are the potential cumulative impacts of the alternatives and how are they assessed?
- **Cooperating Agencies (Section 6.8):** Who are the cooperating agencies involved in preparing and implementing this PDARP/PEIS?
- **Compliance with Other Applicable Authorities (Section 6.9):** What are the primary laws and executive orders relevant to the PDARP/PEIS at this programmatic level?
- **Sections 6.10 through 6.13:** What are other required findings under NEPA in terms of unavoidable adverse impacts, the relationship of short-term uses of the human environment and the maintenance and enhancement of long-term productivity, and irreversible and irretrievable commitment of resources?
- **Consideration of the Effects of Climate Change (Section 6.14):** How is climate change considered in this analysis?
- **Best Practices (Section 6.15):** What are best practices that could be implemented to further reduce potential effects on various resources on a project-specific basis?
- **Environmental Justice Considerations in Future Restoration Planning (Section 6.16):** What are environmental justice considerations that should be included in future restoration plans?
- **NEPA Considerations and Tiering Future Restoration Planning (Section 6.17):** How will NEPA analyses for future restoration plans be tiered relative to this PDARP/PEIS?
- ***Deepwater Horizon* Draft PDARP/PEIS Repositories (Section 6.18):** To whom were copies of this Draft PDARP/PEIS sent?
- **List of Preparers (Section 6.19):** Who prepared this Draft PDARP/PEIS?
- **References (Section 6.20):** What references are cited in this chapter?
- **Best Practices (Appendix 6.A):** What are examples of potential mitigation measures and best practices that could be implemented to further reduce potential effects on various resources on a project-specific basis?

- **Additional Actions for Consideration in Cumulative Impacts Analysis (Appendix 6.B):** What are examples of cumulative actions that are ongoing in the Gulf of Mexico?
- **Cooperating Agency Correspondence (Appendix 6.C):** What correspondence documents the status of the listed cooperating agencies?
- **Other Laws and Executive Orders (Appendix 6.D):** What are the federal laws and executive orders that may be relevant to regulatory compliance for future projects?

6.1 Intent of the Chapter

Actions undertaken by federal Trustees to restore natural resources or services under the Oil Pollution Act (OPA) are subject to the National Environmental Policy Act (NEPA), 42 USC § 4321, *et seq*., and the regulations guiding its implementation at 40 CFR § 1500 (see 15 CFR § 990.23). NEPA and its implementing regulations set forth a process of environmental impact analysis, documentation, and public review for federal actions. NEPA provides a mandate and a framework for federal agencies to consider environmental effects[1] of their proposed actions[2] and to inform and involve the public in their environmental analysis and decision-making process. Preparation of an environmental impact statement (EIS) is required for a major federal action significantly affecting the quality of the human environment" (42 USC § 4332(C)).

The Trustees have integrated OPA and NEPA processes in this Draft PDARP/PEIS. This integrated process allows the Trustees to meet the public involvement requirements of these statutes concurrently. This Draft PDARP/PEIS complies with NEPA by 1) describing the purpose and need for restoration action in Chapter 5, Restoring Natural Resources; 2) summarizing the current environmental setting and affected environment in Chapter 3, Ecosystem Setting, and Chapter 4, Injury to Natural Resources; 3) developing programmatic restoration alternatives in Chapter 5, Restoring Natural Resources, 4) analyzing potential environmental effects in Chapter 6, Environmental Consequences and Compliance with Other Laws and 5) incorporating public participation in the decision process as described in Chapter 1, Section 1.7, Public Involvement in Restoration Planning. Table 6.1-1 above summarizes the location of these elements and other required NEPA information. The Trustees will consider all relevant public comments received during the public comment period in developing the Final PDARP/PEIS.

Effects

There are two types of effects: 1) direct effects, which are caused by the action and occur at the same time and place and 2) indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, as well as related effects on air and water and other natural systems, including ecosystems.

Environmental Impact Statement (EIS)

"a detailed written statement as required by section 102(2)(C) of the National Environmental Policy Act." (40 CFR § 1508.11).

[1] Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial." (40 CFR § 1508.8)

[2] For the purpose of NEPA, the proposed action represents the preferred restoration alternative as described in Section 5.5, Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative). Comprising restoration types that, as a portfolio, address the Trustee's goals, the proposed action includes the restoration approaches presented in Appendix 5.D, Restoration Approaches and OPA Evaluation.

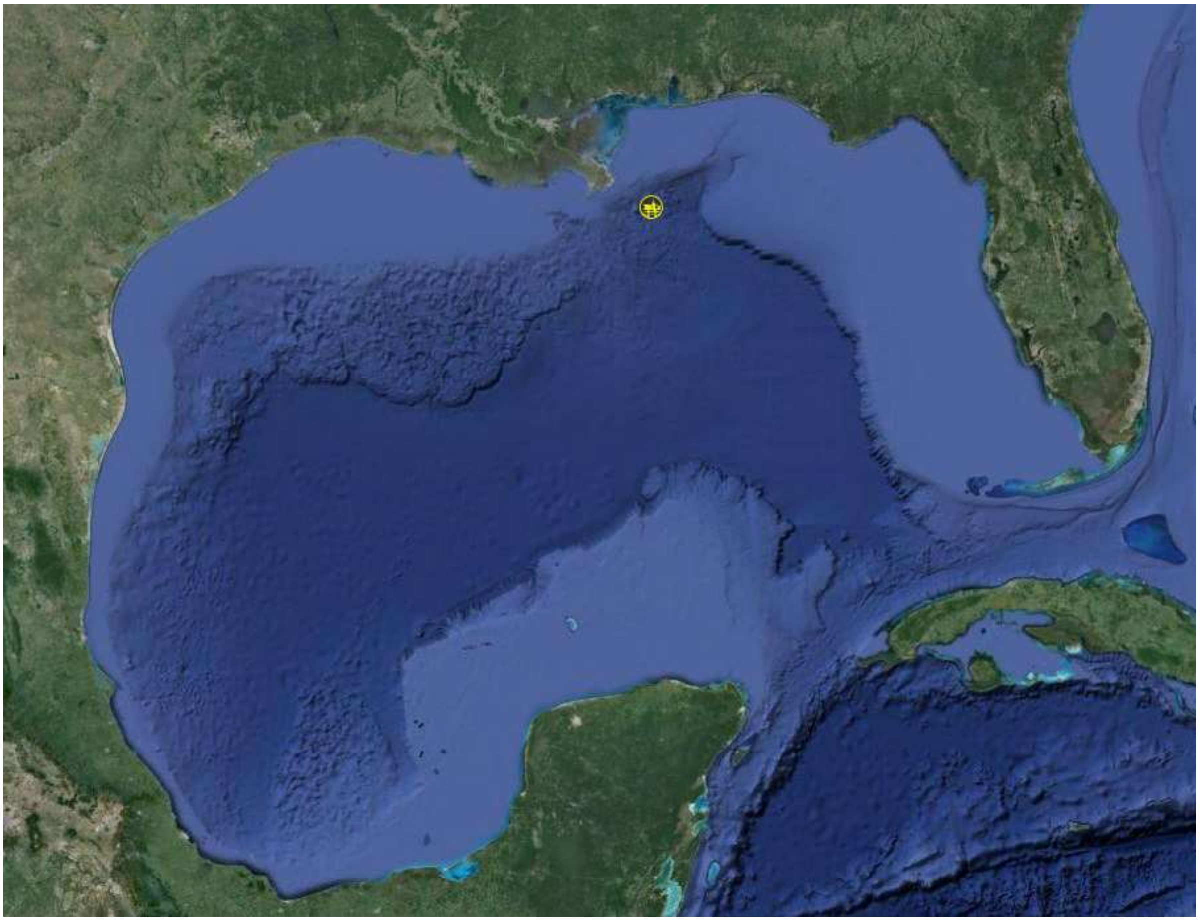
The rationale for preparing a programmatic DARP is provided in Chapter 5.2.2, Scope and Programmatic Context of Restoration Planning. In addition, a federal agency may prepare a programmatic EIS (PEIS) to evaluate broad actions, including similar actions that share common timing and geography. (40 CFR § 1502.4(b); (CEQ 1981)). When a federal agency prepares a PEIS, the agency may "tier" subsequent, narrower environmental analyses on site specific plans or projects from the PEIS (40 CFR § 1502.4(b); 40 CFR § 1508.28). Federal agencies are encouraged to tier subsequent, narrower analyses from a PEIS to eliminate repetitive discussions of the same issues and focus on the actual issues ripe for decision at each level of environmental review (40 CFR § 1502.20). In this light, the Draft PDARP/PEIS evaluates a range of restoration approaches to enable narrower NEPA analyses for subsequent restoration plans to tier from this programmatic analysis. The appropriate level of NEPA analysis for each restoration plan will be determined by the lead federal agency for each plan and will be developed by each Trustee Implementation Group (TIG) (see Chapter 7). The subsequent restoration plans and NEPA analyses will be made available for public review and comment. Further discussion of future implementation, tiered NEPA analyses for subsequent restoration plans, and future public involvement is presented in Section 6.17, NEPA Considerations and Tiering Future Restoration Planning and Chapter 7, Governance.

6.2 Approach to Affected Environment

NEPA requires a description of the existing environment that has the potential to be affected by the alternatives under consideration, with emphasis commensurate with the importance of the impact on those resources (40 CFR § 1502.15). The nature of this programmatic plan necessitates that this information be presented broadly in this Draft PDARP/PEIS and at a refined scale through the course of subsequent restoration plans that are developed consistent with this Draft PDARP/PEIS. The affected environment is a complex ecosystem comprising habitats, associated biological communities, and the physical environment upon which they depend. The complexity of the Gulf of Mexico ecosystem, the magnitude of restoration remaining to restore injuries to this system, and the need for consideration of environmental consequences associated with the proposed restoration actions require consideration of effects at the ecosystem level and consideration of the linked systems and processes within that ecosystem.

The main geographic focus of the Trustees' natural resource damage assessment and restoration efforts is the northern Gulf of Mexico (Figure 6.2-1, below[3]). The scope, nature, and magnitude of the spill caused impacts to coastal and oceanic ecosystems ranging from the deep ocean floor, through the oceanic water column, to the highly productive coastal habitats of the northern Gulf, including estuaries, shorelines, and coastal marshes. Affected resources include multiple species, some of which are threatened and endangered and/or recreationally and commercially important, as well as their habitats in the Gulf and along the coastal areas of Texas, Louisiana, Mississippi, Alabama, and Florida. These species and their habitats are an integral part of the Gulf of Mexico ecosystem. As many of these resources consist of highly migratory species, restoration efforts for some species may be conducted in habitats that occur outside of the Gulf of Mexico. Examples include important breeding grounds for migratory birds in the northern United States, important fisheries in the Atlantic, or sea turtle nesting habitat on beaches in Mexico.

[3] For geographic context, Figure 6.2-1 depicts all of the Gulf of Mexico.



Source: *NOAA Environmental Response Management Application.*

Figure 6.2-1. The Gulf of Mexico covers approximately 600,000 square miles and is bordered by the five Gulf states, Mexico, and Cuba. A yellow marker shows the location of BP's Macondo well.

An overview of the ecosystem setting is presented in Chapter 3, including information on migratory ranges for resources that may spend only a portion of their life cycle within the Gulf of Mexico and otherwise depend on environments elsewhere. Chapter 3 focuses on the importance of the northern Gulf of Mexico ecosystem and the connections between the northern Gulf and other larger systems that exist via resource connectivity (flyways and migratory pathways) and economic transfers through commerce. Chapter 4, Injury to Natural Resources describes how key species, resources, and resource services were injured as a result of the *Deepwater Horizon* incident and provides important information on the existing environment in which proposed restoration must be considered. The chapter's subsections providing an introduction and importance of resources and the key aspects of the injury for restoration planning inform the affected environment for NEPA purposes.

More specific information on the affected environment will be a part of subsequent, project-specific restoration plans in order to provide the level of detail needed to fully evaluate potential environmental consequences of future proposed actions. For example, there are areas designated as critical habitat for a number of Endangered Species Act (ESA)-listed species in the northern Gulf of Mexico, including

loggerhead sea turtles, smalltooth sawfish, Gulf sturgeon, beach mice, and piping plover.[4] A brief discussion of the potential for modification of critical habitat is considered at this programmatic level, where appropriate. Future restoration plans will provide evaluation based on the specific project detail and location.

[4] Detailed descriptions of critical habitat for each of these species can be found at *http://sero.nmfs.noaa.gov/protected_resources/section_7/threatened_endangered/Documents/sero.pdf* (National Marine Fisheries Service-managed species) and at *http://ecos.fws.gov/crithab/* (U.S. Fish and Wildlife Service-managed species).

6.3 Approach to Evaluation of Environmental Consequences

This section describes and compares the potential environmental consequences of the proposed action by evaluating the restoration approaches that make up the alternatives described in the Draft PDARP/PEIS. In developing this integrated PEIS, the Trustees adhered to the procedural requirements of NEPA, the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR §§ 1500-1508), and NOAA's procedural requirements for implementing NEPA.[5]

6.3.1 Alternatives Considered in the PEIS

As described in Chapter 1, the Trustees are, in part, evaluating a programmatic decision regarding how natural resource damage settlement funds in the amount of $8.1 billion (plus up to $700 million for adaptive management for unknown conditions) would be used for restoration to address the natural resource injuries described in this document. Each action alternative developed in Chapter 5, Restoring Natural Resources, emphasizes a different comprehensive restoration planning philosophy. These programmatic alternatives are described and evaluated under OPA in Chapter 5, and the alternatives are briefly described again in this chapter to support the focus here on the evaluation of direct, indirect, and cumulative impacts in accordance with NEPA. As presented in Chapter 5, the Trustees considered a reasonable range of alternatives to restore for the injuries caused by the *Deepwater Horizon* incident. Brief descriptions of the restoration philosophy for each alternative is provided below.

Both Alternatives A, Comprehensive Integrated Ecosystem Restoration (preferred alternative), and B, Resource-Specific Restoration, are further defined by restoration types, and both include all of the restoration types described in Section 5.5 and in summary form in Section 6.4, Evaluation of Environmental Consequences of Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative). Alternatives A and B consist of a portfolio of restoration types that restore, protect, or enhance habitats, resources, and services. Each restoration type consists of one or more proposed restoration approaches, as summarized for Alternative A in Table 6.3-1. Although Alternatives A and B include the same set of restoration types, they differ in their emphasis on coastal habitat restoration and ecological interconnectivity compared with their emphasis on living coastal and marine resources.

Alternative C (Continue Injury Assessment and Defer Comprehensive Restoration Planning), describes continuing assessment, evaluation, and modeling of injuries to increase the certainty of the injury assessment prior to conducting restoration planning. Under this scenario, Alternative C may include the restoration types presented for Alternatives A and B, or could include additional or different restoration types and distribution of effort among the restoration types. All additional restoration would be deferred under Alternative C until such time as a comprehensive restoration plan is proposed and selected by the Trustees.

[5] NOAA Administrative Order (NAO) Series 216-6, Environmental Review Procedures for Implementing the National Environmental Policy Act (NAO 216-6); the Department of the Interior NEPA regulations, 40 CFR Part 46.

Alternative D, Natural Recovery/No Action, evaluates a no-action alternative under NEPA that parallels a natural recovery alternative under OPA. No additional restoration, except for NRDA Early Restoration, would be implemented under NRDA in Alternative D. To allow for a meaningful analysis, the environmental consequences of each restoration approach are evaluated and presented. A summary of cumulative environmental impacts from implementing the alternatives in light of other past, present, and reasonably foreseeable future actions is also included at this programmatic level. This chapter concludes with a comparison of the environmental consequences among the four programmatic alternatives.

Table 6.3-1. Summary of *Deepwater Horizon* PDARP/PEIS restoration types and restoration approaches proposed under Alternative A.

Restoration Type	Restoration Approach
Wetlands, coastal, and nearshore habitats	Create, restore, and enhance coastal wetlands
	Restore and preserve Mississippi-Atchafalaya River processes
	Restore oyster reef habitat (see Section 6.4.12.1 under the restoration type Oysters)
	Create, restore, and enhance barrier and coastal islands and headlands
	Restore and enhance dunes and beaches
	Restore and enhance submerged aquatic vegetation (SAV; see Section 6.4.8.1 under the restoration type Submerged Aquatic Vegetation)
	Protect and conserve marine, coastal, estuarine, and riparian habitats
Habitat projects on federally managed lands	Create, restore, and enhance coastal wetlands (see Section 6.4.1.1 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Restore oyster reef habitat (see Section 6.4.12.1 under the restoration type Oysters)
	Create, restore, and enhance barrier and coastal islands and headlands (see Section 6.4.1.3 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Restore and enhance dunes and beaches (see Section 6.4.1.4 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Restore and enhance submerged aquatic vegetation (see Section 6.4.8.1 under the restoration type SAV)
	Protect and conserve marine, coastal, estuarine, and riparian habitats (see Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Promote environmental stewardship, education, and outreach (see Section 6.4.13.3 under the restoration type Provide and Enhance Recreational Opportunities)
Nutrient reduction (nonpoint source)	Reduce nutrient loads to coastal watersheds
	Reduce pollution and hydrologic degradation to coastal watersheds (see Section 6.4.4.1 under the restoration type Water Quality)
	Create, restore, and enhance coastal wetlands (see Section 6.4.1.1 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Protect and conserve marine, coastal, estuarine, and riparian habitats (see Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
Water quality (e.g., stormwater treatments, hydrologic restoration, reduction of sedimentation, etc.)	Reduce pollution and hydrologic degradation to coastal watersheds
	Reduce nutrient loads to coastal watersheds (see Section 6.4.3.1 under the restoration type Nutrient Reduction [Nonpoint Source])
	Create, restore, and enhance coastal wetlands (see Section 6.4.1.1 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Protect and conserve marine, coastal, estuarine, and riparian habitats (see Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
Fish and water column invertebrates	Gear conversion and/or removal of derelict fishing gear to reduce impacts of ghost fishing
	Reduce mortality among Highly Migratory Species and other oceanic fishes
	Voluntary reduction in Gulf menhaden harvest
	Incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship

Restoration Type	Restoration Approach
	Enhance development of bycatch reducing technologies
	Reduce post-release mortality of red snapper and other reef fishes in Gulf of Mexico recreational fishery using fish descender devices
	Reduce Gulf of Mexico commercial red snapper or other reef fish discards through IFQ[a] allocation subsidy program
Sturgeon	Restore sturgeon spawning habitat Reduce nutrient loads to coastal watersheds (see Section 6.4.3.1 under the restoration type Nutrient Reduction [Nonpoint Source]) Protect and conserve marine, coastal, estuarine, and riparian habitats (see Section 6.4.1.5 under the Wetlands, Coastal, and Nearshore Habitats)
Sea turtles	Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures
	Reduce sea turtle bycatch in commercial fisheries through enhanced training and outreach to the fishing community
	Enhance sea turtle hatchling productivity and restore and conserve nesting beach habitat
	Reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures
	Reduce sea turtle bycatch in commercial fisheries through enhanced state enforcement effort to improve compliance with existing requirements
	Increase sea turtle survival through enhanced mortality investigation and early detection of and response to anthropogenic threats and emergency events
	Reduce injury and mortality of sea turtles from vessel strikes
	Reduce mortality among Highly Migratory Species and other oceanic fishes (see Section 6.4.5.2 under the restoration type Fish and Water Column Invertebrates)
Submerged aquatic vegetation	Restore and enhance submerged aquatic vegetation
Marine mammals	Reduce commercial fishery bycatch through collaborative partnerships
	Reduce injury and mortality of bottlenose dolphins from hook and line fishing gear
	Increase marine mammal survival through better understanding of causes of illness and death and early detection and intervention of anthropogenic and natural threats
	Measurement of noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals
	Reduce injury, harm, and mortality to bottlenose dolphins by reducing illegal feeding and harassment activities
	Reduce marine mammal takes through enhanced state enforcement related to the Marine Mammal Protection Act
	Reduce injury and mortality of marine mammals from vessel collisions
	Protect and conserve marine, coastal, estuarine, and riparian habitats (see Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
Birds	Restore and conserve bird nesting and foraging habitat
	Create, restore, and enhance coastal wetlands (see Section 6.4.1.1 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Restore and enhance dunes and beaches (see Section 6.4.1.4 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Create, restore, and enhance barrier and coastal islands and headlands (see Section

Restoration Type	Restoration Approach
	6.4.1.3 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Restore and enhance submerged aquatic vegetation (see Section 6.4.8.1 under the restoration type Submerged Aquatic Vegetation)
	Protect and conserve marine, coastal, estuarine, and riparian habitats (see Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Establish or re-establish breeding colonies
	Preventing incidental bird mortality
Mesophotic and deep benthic communities	Coral transplantation and placement of hard ground substrate
	Protect and manage mesophotic and deep benthic coral communities
Oysters	Restore oyster reef habitat
Provide and enhance recreational opportunities	Enhance public access to natural resources for recreational use
	Enhance recreational experiences
	Promote environmental stewardship, education, and outreach
	Create, restore, and enhance coastal wetlands (see Wetlands, coastal, and nearshore habitats section)
	Restore oyster reef habitat (see Section 6.4.12 under the restoration type Oysters)
	Create, restore, and enhance barrier and coastal islands and headlands (see Section 6.4.1.3 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Restore and enhance dunes and beaches (see Section 6.4.1.4 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
	Restore and enhance submerged aquatic vegetation (see Section 6.4.8.1 under the restoration type Submerged Aquatic Vegetation)
	Protect and conserve marine, coastal, estuarine, and riparian habitats (see Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats)

IFQ = individual fishing quota.

6.3.2 Determining the Level of Impact

Under NEPA, federal agencies must consider the potential environmental impacts of proposed actions. These effects may include, among others, impacts to social, cultural, and economic resources, as well as natural resources. To identify those resources that could be significantly affected by the proposed alternatives and actions, appropriate definitions of *impacts* must first be identified. Table 6.3-2 provides resource-specific guidelines for determining impacts of the programmatic alternatives.

As defined in NEPA, evaluations should include direct, indirect, and cumulative effects. Effects are defined in the CEQ regulations (40 CFR §§ 1508.8 and 1508.7) as follows:

- **Direct effects**, which are caused by the action and occur simultaneously to the activity and at the same place.
- **Indirect effects**, which are caused by the action and occur later in time or are farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population

density, or growth rate and related effects on air and water and other natural systems, including ecosystems.

- **Cumulative effects** are the impact on the environment that 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 nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

This Draft PDARP/PEIS describes and evaluates both adverse and beneficial impacts to the natural and human environments. In order to determine whether an action has the potential to result in significant impacts under NEPA, the **magnitude** of the impact, with respect to *context* and *intensity* of the action must be considered. The qualitative assessment of impacts is based on a review of available and relevant reference material and professional judgment, using standards that include consideration of the permanence of an impact, the uniqueness of or ability to replace the resource, and the abundance or scarcity of the resource.

Context refers to area of impacts (local, statewide, etc.) and their duration (e.g., whether they are short- or long-term impacts). An impact lasting for a finite period and of short duration relative to the proposed restoration project and the environmental resource is considered short-term for purposes of this Draft PDARP/PEIS. In general, the impacts of construction and associated activities (e.g., vehicle use, use of staging areas for equipment or area closure) undertaken to implement a restoration project are expected to be short-term, and the impacts that persist beyond construction are expected to be long-term. These characteristics are determined on a case-by-case basis and do not refer to any specific time period.

Intensity refers to the severity of impact and could include the timing of the action (e.g., more intense impacts would occur during critical periods such as high visitation or wildlife breeding/rearing). Intensity is also described in terms of whether the impact would be beneficial or adverse. A single act might result in adverse impacts on one resource and beneficial impacts on another resource. An adverse impact is one having unfavorable or undesirable outcomes on the manmade or natural environment. Each adverse impact is described by one of the following terms:

- **Minor.** Minor impacts are generally those that might be detectable but, in their context, may nonetheless not be measurable because any changes they cause are so slight as to be impossible to define.
- **Moderate.** Moderate impacts are those that are more detectable and, typically, more quantifiable or measureable than minor impacts.
- **Major.** Major impacts are those that, in their context and due to their severity, have the potential to meet the thresholds for

Significance

"When used in NEPA, this word requires consideration of both context and intensity. For context, an action must be analyzed in several contexts such as society as a whole, the affected region, the affected interests, and the locality. For intensity, an action must be analyzed with respect to the severity of impact." (40 CFR § 1508.27)

significance set forth in CEQ regulations (40 CFR § 1508.27) and, thus, warrant heightened attention and examination for potential benefit of mitigation.

A beneficial impact is one that creates a positive outcome in the manmade or natural environment. Because restoration conducted as part of this Draft PDARP/PEIS is intended to result in significant, major benefits to injured resources, evaluation of the intensity of the benefits to resource categories is not described. For resource areas where there is no expected effect from project activities, a "no-impact" conclusion is made.

The potential programmatic environmental consequences described in this chapter are presented largely without factoring in the types of best practices that could be used to avoid or minimize the potential adverse effects at a project-specific level. Such practices can be established during project planning and implementation. An exception is the analysis of impacts to protected biological resources and their habitats. For these resources, restoration types were specifically analyzed with the incorporation of best practices in Section A.1 of Appendix 6.A, Best Practices, that would be typically required by regulating agencies because these projects generally would not be able to move forward through agency review without incorporation of best practices. Such best practices include but are not limited to steps taken through site selection, engineering and design, use of proven restoration techniques and best practices, and other conditions or activities required for project-specific regulatory compliance. All projects implemented under subsequent restoration plans and tiered NEPA analyses consistent with this Draft PDARP/PEIS would secure all necessary state and federal permits, authorizations, consultations, or other regulatory processes, including those related to sensitive habitats (e.g., wetlands or EFH) and protected species (e.g., marine mammals, such as dolphins, or federally listed species, such as sea turtles). Projects will also be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

Chapter 5, Section 5.4.3, Early Restoration, describes the Early Restoration process undertaken by the Trustees and references restoration plans and the associated environmental reviews. These Early Restoration projects were evaluated by the Trustees with consideration of environmental impacts to physical, biological, and socioeconomic resources. Appendix 5.B, Early Restoration, Table 5.B-1, identifies the project, Early Restoration phase, geographic area (state- or Gulf-wide), and restoration type that the project is associated with. Analysis of the effects of these actions was considered in the evaluation of restoration approaches considered in this Draft PDARP/PEIS.

This chapter evaluates the potential environmental impacts of restoration approaches, acknowledging that the selection of a programmatic alternative and associated restoration approaches do not in themselves result in environmental impacts; impacts would occur as a result of projects ultimately identified and selected in future project-specific actions that tier from this PDARP/PEIS. The intensity definitions, as presented in Table 6.3-2, are used in this Draft PDARP/PEIS for identifying adverse impacts of the proposed restoration approaches. These intensity definitions are also designed for use in subsequent tiered documents. The analysis uses the intensity definitions in evaluating whether the proposed restoration approaches may result in minor, moderate, or major adverse impacts. Section 6.4, Evaluation of Environmental Consequences of Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative), presents a summary of the findings of these analyses for each proposed restoration approach.

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

Resource	Impact Duration	Impact Intensity Definitions: Minor	Impact Intensity Definitions: Moderate	Impact Intensity Definitions: 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 groundwater flows. Water Quality: Impacts could result in a detectable change to water quality, but the change could be expected to be small and localized. Impacts could quickly become undetectable. State water quality standards as required by the Clean Water Act could not be exceeded. Floodplains: Impacts may result in a detectable change to natural and beneficial floodplain values, but the change could be expected to be small, and localized. There could be no appreciable increased risk of flood loss including impacts on human safety, health, and welfare. Wetlands: The effect on wetlands could be measurable but small in terms of area and the nature of the impact. A small impact on the size, integrity, or connectivity could occur; however,	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 groundwater 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 groundwater 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
		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 widescale area, possibly river-basin wide. Disturbances could result in a decrease in fish species diversity and populations. The viability of some species could be affected. Species movements could be seasonally constrained or eliminated. Actions could result in the widespread increase of non-native species resulting in broad and permanent changes to native

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				
Socioecono-mics 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.
Tourism and	Short-term: During	There could be partial developed	There could be complete site closures to	All developed site capacity could be

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
Recreational Use	construction period. Long-term: Over the life of the project or longer.	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 recreationalists. 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.	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 recreationalists 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.	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 recreationalists 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).
Aesthetics and Visual Resources	Short-term: During construction period.	There could be a change in the view shed that was readily apparent but could not attract attention, dominate the view, or	There could be a change in the view shed that was readily apparent and attracts attention. Changes could not	Changes to the characteristic views could dominate and detract from current user activities or experiences.

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
	<u>Long-term:</u> Over the life of the project or longer.	detract from current user activities or experiences.	dominate the viewscape, although they could detract from the current user activities or experiences.	
Public Health and Safety, Including Flood and Shoreline Protection	<u>Short-term:</u> During construction period. <u>Long-term:</u> Over the life of the project or longer.	Actions could not result in 1) soil, groundwater, 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, groundwater, 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, groundwater, or surface water to an extent that requires mitigation; and/or 2) could introduce detectable levels of contaminants to soil, groundwater, 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, groundwater, 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, groundwater, 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, groundwater, or surface water within the project area, exposing workers and/or the public to contaminated or hazardous materials at levels exceeding those permitted by 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.

6.4 Evaluation of Environmental Consequences of Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative)

As presented in Chapter 5, Restoring Natural Resources, three restoration alternatives are considered that meet the Trustees' identified need for a comprehensive restoration approach closely linked to injury that will guide and direct subsequent development and selection of specific restoration projects. Per NEPA, a fourth, no-action alternative is also considered.

Alternative A would establish an integrated restoration portfolio that emphasizes the broad ecosystem benefits that can be realized through coastal habitat restoration in combination with resource-specific restoration in the ecologically interconnected northern Gulf of Mexico ecosystem. As presented in Chapter 5, it comprises restoration types that restore for injuries to nearshore habitats, living coastal and marine resources, and recreational use. Organized within these restoration types, restoration approaches (Table 6.3-1) are evaluated for the environmental consequences of taking such actions. Appendix 5.D, Restoration Approaches and OPA Evaluation, describes 39 individual restoration approaches that could be used to implement the restoration plan, with descriptions of each, implementation considerations, and an OPA appropriateness evaluation. Below, the restoration approaches are evaluated individually[6] with respect to potential impacts to physical, biological, and socioeconomic resources. Following individual analysis by restoration approach, the environmental consequences of implementing Alternative A are summarized.

6.4.1 Restoration Type: Wetlands, Coastal and Nearshore Habitats

The following restoration approaches are proposed for wetlands, coastal and nearshore habitats:

- Create, restore, and enhance coastal wetlands.
- Restore and preserve Mississippi-Atchafalaya River processes.
- Restore oyster reef habitat (see Section 6.4.12.1 under the restoration type Oysters).
- Create, restore, and enhance barrier and coastal islands and headlands.
- Restore and enhance dunes and beaches.
- Restore and enhance submerged aquatic vegetation (SAV; see Section 6.4.8.1 under the restoration type Submerged Aquatic Vegetation).

[6] As described in Section 5.4, Approach to Developing and Evaluating Alternatives, the restoration types and restoration approaches are building blocks for comprehensive restoration plan alternatives, which also must meet the Trustees' programmatic goals. As such, some restoration approaches fall under more than one restoration type. Because the environmental consequences would not differ based on the type of restoration implemented, restoration approaches are evaluated once, even if they are supportive of more than one restoration type. For example, "Restore oyster reef habitat" is an approach that supports both Wetlands, Coastal, and Nearshore Habitats and Oysters. It is noted in Section 6.4.1 under the first restoration type; however, its evaluation is presented in Section 6.4.12, Restoration Type: Oysters.

- Protect and conserve marine, coastal, estuarine, and riparian habitats.

The following sections describe the environmental consequences of these approaches. The approach for "Restore and enhance submerged aquatic vegetation" (SAV) is described in Section 6.4.8. The approaches related to oyster restoration are presented in Section 6.4.12.

6.4.1.1 Create, Restore, and Enhance Coastal Wetlands

This restoration approach focuses on the creation, restoration, and enhancement of coastal wetlands, including marshes, mangroves, and pine savannahs, that provide benefits to injured resources through the replacement of injured wetland resources, provision of habitat for injured faunal resources and/or their prey, and improvement of water quality to benefit injured resources in coastal watersheds. Coastal wetlands are the backbone of the northern Gulf of Mexico coastal and nearshore ecosystem, providing a wide range of important ecological functions and services. They also serve as important habitat for fish and wildlife species, improve water quality, stabilize shorelines, reduce storm surge, and capture and store carbon in organic soils (Armentano & Menges 1986; Costanza et al. 2014; Costanza et al. 2008; Moody & Aronson 2007; Woodward & Wui 2001; Zimmerman et al. 2000). There are multiple restoration techniques that can be used, individually, or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Create or enhance coastal wetlands through placement of dredged material.
- Backfill canals.
- Restore hydrologic connections to enhance coastal habitats.
- Construct breakwaters.

The following programmatic analysis is intended to capture potential broad impacts from a variety of techniques that may be proposed under this approach in future restoration plans.

6.4.1.1.1 Physical Resources

Short-term and long-term, minor to moderate adverse impacts on the physical environment could result from construction activities related to creating, restoring, and enhancing coastal wetlands. Short-term impacts could result from the use of staging areas (causing water turbidity from sediment disturbance) and construction equipment (releasing emissions causing adverse air quality and noise impacts from the operation of machinery). Short-term, minor to moderate noise impacts associated with construction activities could temporarily displace human use of those areas; however, this approach is expected to be implemented outside of densely populated areas. Construction of hard structures such as breakwaters can involve use of heavy equipment on the shoreline and barges that can cause direct localized and short-term, moderate adverse impacts from sediment disturbance and compaction, increased turbidity, and noise as the materials are placed in the designed configuration. Long-term, minor adverse indirect impacts on the physical environment could occur from the placement of dredged material and breakwaters in shallow water areas, which may affect sediment dynamics. Placement of materials (such as dredged material or riprap) would result in long-term, but localized, adverse impacts to the existing substrate. Hydrology also may be affected where tidal connectivity is modified per project design. However, projects would typically require implementation of best practices to minimize or avoid adverse impacts. Best practices, such as silt curtains, buffer zones, and water quality monitoring, would be used to minimize such effects.

This approach will benefit wetlands and other shoreline habitats by raising substrate elevations affected by subsidence and sea level rise and re-establishing natural hydrology needed to restore the function of coastal wetland communities. Reconnecting coastal wetlands to freshwater sources and/or tidal flooding will restore the natural hydrology of these habitats. This would re-establish natural estuarine salinity gradients and could maintain and improve coastal water quality, benefiting other coastal habitats and resources. This approach also helps stabilize substrates, which increases the resilience of coastal wetlands to sea level rise and reduces coastal erosion. This approach supports linkages within the broader coastal and nearshore ecosystem by restoring the natural movement of water, sediments, energy, and nutrients among habitats.

6.4.1.1.2 Biological Resources

Short-term, minor to moderate adverse impacts to the biological environment could occur during construction activities related to 1) disturbance to wetland vegetation during construction and 2) displacement of land-based or aquatic faunal species resulting from staging equipment and materials, as well as entrapment of marine mammals. Long-term, minor to moderate impacts could include conversion of one wetland vegetation type to another (e.g., saline vegetation to more freshwater vegetation) with changes in the distribution of fauna communities. Some applications of this approach could also result in localized, permanent, adverse impacts to shallow intertidal or subtidal habitat such as that for SAV or oysters, for instance, if fill is placed in these areas to create marsh. These impacts are expected to be confined to the immediate vicinity of the project, and best practices would likely be implemented to minimize adverse impacts.

This approach would provide long-term benefits for many ecologically and economically important animals, including fish, shrimp, shellfish, birds, sea turtles, marine mammals, and terrestrial mammals in the form of food, shelter, breeding, and nursery habitat. Many of the species that directly utilize coastal marshes and mangroves as juveniles later migrate offshore, where they serve as prey for ecologically and economically important open ocean species. Thus, these highly productive habitats support ecological connectivity both within the coastal ecosystem and between the coastal, nearshore, and open ocean ecosystems through the movement of animals that use wetlands during their life cycle to grow and reproduce. A variety of techniques could be implemented under this approach, and subsequent projects implementing these techniques would be designed to maximize ecological benefits to animals that depend on coastal wetland habitats.

6.4.1.1.3 Socioeconomic Resources

This approach could result in minor to moderate, localized adverse impacts to socioeconomic resources if a project includes protection of lands that otherwise would have been developed for residential housing or commercial uses. Indirect adverse impacts in the immediate area could occur during construction through 1) limiting recreational activities near the construction area in order to protect public safety; 2) temporarily increasing road traffic due to movement of construction vehicles; and 3) adversely affecting aesthetics due to the presence of construction equipment, new breakwaters, or other changes to the surrounding environment.

Implementation of this approach at national, state, and local parks; wildlife refuges; and wildlife management areas, could result in short-term, minor adverse impacts to land and marine management due to temporary partial or full closure of areas, public access restrictions, and/or interruption of

interpretive programs, if necessary. Long-term benefits for the public are anticipated as a result of the restoration approach. Benefits to the local economy could accrue through an increase in employment and associated spending in the project area during construction. Over the long term, this approach may provide long-term benefits to recreationists through increased opportunities for wildlife viewing, kayaking, canoeing, hunting, fishing, and other recreational activities. Additional indirect benefits could include increased fishing opportunities (both commercial and recreational), which could result from restoring coastal habitats that benefit fish. To the extent that these increased recreational opportunities result in increased visitation, local businesses may benefit from increased expenditures by visitors. This approach may increase property values adjacent to a project site if aesthetics are improved.

Improvements in water quality resulting from increased water filtration from these activities could also contribute long-term benefits to public health. Construction of breakwaters and wetland restoration and enhancement activities could provide benefits to coastal populations and infrastructure through improved flood and shoreline protection. This benefit is particularly effective for low-energy storm events.

Creating, enhancing, or restoring coastal wetlands could result in minor (temporary disturbance) to moderate (disturbance without loss of cultural information) impacts on cultural and historic resources due to construction activities such as dredging, addition of sediments or borrow materials, and/or removal of sediments, depending on the scale of the action and site-specific characteristics. Adverse impacts could include physical destruction or alteration of resources and may alter, damage, or destroy resources such as historic shipwrecks, engineering structures or landscapes, or connectivity with related sites. The Office of Coast Survey's Automated Wreck and Obstruction Information System (AWOIS) database and other relevant studies are available for identification of submersed resources for individual projects. Discovery or recovery of cultural or historic resources would allow the future protection of the resource.

6.4.1.2 Restore and Preserve Mississippi-Atchafalaya River Processes

This restoration approach seeks to provide large-scale benefits for the long-term sustainability of deltaic wetlands in coastal Louisiana by managing river diversions from the Mississippi-Atchafalaya River systems. Flood levees and river channelization have cut deltaic wetlands off from the Mississippi and Atchafalaya Rivers and the sediments, freshwater, and nutrients that originally created them (Boyer et al. 1997; Cahoon et al. 2011; Roberts 1997). Large-scale river management operations aim to re-introduce renewable, sustainable sources of sediment that are necessary for the long-term replenishment and sustainability of the deltaic wetlands in this region (Day et al. 2007; Kemp et al. 2014; Kim et al. 2009; Paola et al. 2011; Wang et al. 2014). River diversions represent a long-term strategy to restore injured wetlands and resources by reducing widespread loss of existing wetlands. This large-scale restoration approach aims to increase the long-term resilience and sustainability of other wetland restoration implemented in the region (Day et al. 2007; Kemp et al. 2014). Sediment diversions primarily redirect coarse-grained, river bedload into deltaic wetlands and the shallow nearshore environment, although inherently freshwater and finer-grained silt will be diverted as well. The anticipated performance of diversions is a function of many factors, including but not limited to location, available sediment, velocity, river stage, outfall management, physical and ecological characteristics of the discharge area, and operational management of the diversion. Diversion-related impacts are also a

function of these factors, the magnitude of which will be predicted during project-specific planning, engineering, and design and will not be known until completion of construction and the initiation of operations and adaptive management.

As such, the Trustees anticipate that most diversions that may be proposed in subsequent restoration plans would require preparation of an EIS(s) tiered from this PEIS to evaluate the impacts and benefits of those respective diversion(s), both as individual projects or a suite of projects where appropriate. Thorough engineering and design, and associated project and watershed hydrodynamic and ecologic modeling, will be critical in completing project-level EISs. The Louisiana Coastal Protection and Restoration Authority (LCPRA) has spent years conducting river and diversion studies, the largest being the Mississippi River Hydrodynamic and Delta Management restoration study, an ongoing joint study conducted by the LCPRA and U.S. Army Corps of Engineers (USACE). This study identifies and evaluates a combination of large-scale management and restoration features to address the long-term sustainability of the Mississippi-Atchafalaya delta region. It is intended to help guide the multiple uses of the river system; determine the magnitude of impacts; help identify project scale, scope, and location; and evaluate diversion alternatives. Hydrodynamic models and other forecasting tools will be used to refine projections of how water and sediment resources could be best used to restore and sustain deltaic growth. The results of this study are still pending, and other additional data collection and analysis may be required to determine project benefits and impacts.

The following sections describe the scope and possible magnitude of potential impacts associated with diversions, which typically are correlated with diversion size. These impacts are discussed in general terms, as no specific diversions are proposed in this Draft PDARP/PEIS, and project-specific impacts could not be known prior to completion of pending studies and project-level engineering and design, which would be evaluated in a subsequent restoration plan and project-specific tiered EIS(s).

6.4.1.2.1 Physical Resources

Localized, long-term, minor to moderate adverse impacts to sediments and geology are possible at the diversion construction site as the structure(s) is installed. Short-term, moderate adverse impacts to surface water quality are possible during diversion operation, which may reduce salinity, alter oxygen concentrations, and increase turbidity. Although considered adverse here, these water quality changes related to sediment and freshwater influx would be similar to those that occur during natural high flow events and are intended to mimic historical delta-building processes.

Some studies have suggested that increased nutrient loading to coastal wetlands could affect marsh soil shear strength and belowground biomass, which could reduce the resilience of the marsh to disturbances such as hurricanes (Deegan et al. 2012; Kearney et al. 2011; Turner 2011). However, studies that have looked specifically at the effects of the existing salinity control structures on soil stability, belowground biomass, and the accumulation of soil organic matter have shown mixed results (Day et al. 2013; DeLaune et al. 2003; DeLaune et al. 2013; Howes et al. 2010; Swarzenski et al. 2008). This impact would likely vary based on the type of vegetation in the receiving marsh (Morris et al. 2013; Teal et al. 2012). Research also indicates that wetlands in the deltaic plain are very efficient at removing nutrients, which should help limit any negative impacts associated with the river's nutrient loads (Day et al. 2003; DeLaune et al. 2005; VanZomeren et al. 2012). Further, the marshes surrounding the mouth of the Atchafalaya River and the uncontrolled Wax Lake outlet diversion in Atchafalaya Bay show

considerable resilience to storm impacts (Carle & Sasser 2015; Rosen & Xu 2013), indicating that high nutrient loads are not negatively affecting the stability of these marshes that receive large amounts of both sediment and freshwater from the Mississippi River. This suggests that negative impacts to soil stability would not be expected for diversions that are specifically designed to deliver high sediment loads.

6.4.1.2.2 Biological Resources

Diversions will periodically increase freshwater and sediment input to the receiving estuary, which can lead to changes in water temperature, clarity, oxygen and nutrient concentrations, and salinity, at least for the duration of the operation of the diversion and for some period of time after the diversion is closed. During these periods of water quality changes, short-term and some potentially long-term, moderate to major adverse impacts to biological resources are possible depending on the level and duration of stress on their biological functions. This could affect the distribution and reproductive patterns of some estuarine-dependent fish species and affect the sustainability of local oyster populations (Soniat et al. 2013). Additionally, oyster reef, estuarine sand/shell substrates, and marshes are identified as Essential Fish Habitat (EFH) for red drum and brown shrimp, both federally managed fisheries (GMFMC & NOAA 2007). Impacts to these habitats could result in in-kind impacts to the species that utilize these habitats. Depending upon the location and operation of the diversion(s), some displacement of certain fisheries may occur during the period of operation or during the residual effects of freshening. Changes in salinity patterns would likely alter marine mammal habitat and/or negatively affect marine mammal health, especially for resident stocks of bay, sound, and estuary (BSE) bottlenose dolphins in the receiving basins that would not be expected to leave their home areas (LaBrecque et al. 2015; Miller 2003; Miller & Baltz 2009; Waring et al. 2015). In addition, short-term, minor impacts to sea turtles and marine mammals may also occur as a result of changes in prey distribution and availability following operation of a large-scale diversion; additionally, sea turtles may be displaced from newly freshwater areas.

Conversely, long-term, moderate to major benefits to biological resources are also anticipated as a result of the restoration of deltaic processes that would increase the resilience of habitat for numerous species. Long-term increases in marsh acreage and health and long-term benefits in the form of restored deltaic processes are expected. Depending on the size and operation, river diversions can regulate salinity fluctuations and improve marsh productivity (Visser et al. 2013). A healthy marsh provides food and cover to juvenile fish, shrimp, crabs, oysters, and other biota.

Impacts to shellfish related to sediment flow are possible due to burial, predation, and salinity stress; injury or mortality due to increased turbidity (e.g., gill abrasion or clogging of feeding apparatus); and modified behavior and displacement due to changing environmental conditions and associated physiological stress (Wilber & Clarke 2001). Adverse impacts to current oyster reefs may be moderate to major and long-term depending on proximity to the diversion outfall and on operations, especially if spat-producing reefs are buried or otherwise do not provide a spat source for other reefs. These impacts could increase mortality, affect reproduction, and affect oyster spat settlement of oysters (Soniat et al. 2013). Freshwater inputs could push optimal salinities for oysters more seaward. Benefits to oyster resources located in higher salinities, however, may result from freshwater inputs, which could reduce salinities and thus the potential for dermo infections (infection by the protozoan parasite *Perkinsus*

marinus) and predation by oyster drills (*Stramonita haemastoma)*, both of which are major threats to oyster survival and productivity in high salinity areas (more than 20 practical salinity units [psu] over oyster reefs) (Petes et al. 2012; Soniat et al. 2012; Wilber & Clarke 2001).

Impacts to finfish related to sediment and freshwater diversions may also result due to increased turbidity (e.g., gill abrasion) or modified behavior and displacement due to changing environmental conditions and associated physiological stress (Wilber & Clarke 2001). Adverse impacts at a population level are not anticipated, and most populations will relocate to appropriate habitat. River diversions also affect water quality in ways that could change the distribution and reproductive patterns of estuarine-dependent fish species (Nyman et al. 2013) and disrupt the nursery functions of an estuary by affecting food and habitat availability (Rozas & Minello 2011; Rozas et al. 2005). Short-term moderate adverse impacts are anticipated to less freshwater-tolerant species, such as brown shrimp, spotted seatrout, and other estuarine-dependent species due to dependence of larvae and juveniles on estuarine conditions (Nyman et al. 2013). These species could be displaced during certain portions of the year, which could affect prey availability and abundance, growth rates, and predation rates (Rose et al. 2009). Species such as Gulf menhaden, blue crab, white shrimp, and red drum, which commonly use intermediate salinity areas, SAV habitats, and oyster reefs, could incur short-term adverse impacts during operation as a result of salinity changes but are anticipated to relocate to appropriate salinities, and potentially to newly restored saltwater marshes.

Freshwater inflow is an important component of circulation and flushing processes in estuaries, which supports the aquatic food web of marine fishery species by transporting planktonic organisms, nutrients, and detritus to the Gulf of Mexico. Freshwater fishery species, such as crawfish, catfish, largemouth bass, and other sunfish could benefit from implementation of this approach due to the increased freshwater input. Also, prior to vegetation establishment in receiving sites, short-term beneficial effects for wading and other shorebirds could occur in the form of expanded loafing, feeding, or nesting areas. There will also be a long-term beneficial effect on these species based on increased prey production derived from improved marsh productivity.

6.4.1.2.3 Socioeconomic Resources

Over the long-term, restoration of the Mississippi-Atchafalaya River processes would be expected to result in overall socioeconomic benefits resulting from the preservation and restoration of coastal wetlands, as well as employment opportunities during the construction of such projects. Both short- and long-term adverse impacts to fisheries could occur, however, as resources and wetlands convert to more freshwater habitats.

Long-term, adverse socioeconomic impacts to the oyster industry are possible, as the diversions may affect oyster mortality and recruitment within the receiving basin, or shift oyster resources further south, thus increasing travel time and harvesting costs. Likewise, shifts in marine fisheries distribution could increase industry costs. In addition to fisheries, diversions could increase flooding frequency and duration that may affect commercially important terrestrial species (e.g., alligators). If such animals are affected, activities such as trapping, egg collection, and hunting opportunities may also be affected.

Impacts to cultural resources resulting from the implementation of this restoration technique are dependent on site-specific conditions associated with a proposed project. Creating, enhancing, or

restoring wetlands could result in minor (temporary disturbance) to moderate (disturbance without loss of cultural information) impacts on cultural and historic resources due to construction activities such as dredging, addition of sediments or borrow materials, and/or removal of sediments. Adverse impacts could include physical destruction or alteration of resources such as historic shipwrecks, engineering structures or landscapes, or connectivity between related sites.

Commercial navigation may be adversely affected by diversion-induced river shoaling. Diversions have the potential to change currents in the river and affect navigational safety. Navigation channel safety is a significant driver of dredging operations in the Mississippi River; the extent to which dredging operations may be affected will depend on project specifics. The previously mentioned Mississippi River Hydrodynamic and Delta Management restoration study, in part, considers diversion impacts to river dynamics and shoaling.

Diversions that contribute to the preservation or restoration of wetlands are expected to benefit public and private landowners; however, in the immediate areas of diversions there could be flooding of wetland areas during periods of operation. Over the long-term, however, land gain resulting from diversions may provide a buffer from storm surge and sea level rise to help protect coastal communities and landowners.

6.4.1.3 Create, Restore, and Enhance Barrier and Coastal Islands and Headlands

This restoration approach focuses on restoring barrier and coastal islands, which would provide coastal habitat important to coastal stability and ecology in the Gulf of Mexico. Barrier island restoration has a long history, particularly in Louisiana where more than 20 projects have been conducted in the last two decades (CPRA 2012). Barrier and coastal islands and headlands provide important habitat for many animal and plant species including, but not limited to, sea turtles, birds, and endangered beach mice. Multiple restoration techniques are available for use individually, or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Restore or construct barrier and coastal islands and headlands via placement of dredged sediments.
- Plant vegetation on dunes and back-barrier marsh.

6.4.1.3.1 Physical Resources

Construction associated with restoration of barrier and coastal islands and headlands can result in direct, short-term adverse impacts to geology, substrates, water quality, and air quality from sediment handling at both the borrow site (sediment source) and the placement site. Local noise levels and vehicle emissions would increase temporarily, and minor to major adverse impacts from noise may occur, particularly at large barrier island restoration projects where sediment addition activities may occur over many months. The severity of these physical impacts is expected to be minor to major and would depend to a large degree on the location of the project, the amount of disturbance that these activities would generate, and the distance to sensitive receptors such as recreational users or wildlife.

6.4.1.3.2 Biological Resources

There may be direct short-term adverse impacts to benthic habitats during construction of barrier and coastal islands and headlands due to temporary placement of pipelines (for transport of sediments) and temporary storage of dredged sediments in nearshore habitats. Long-term adverse impacts may also occur due to final placement of sediment in the footprint where existing habitats would be covered by additional sediment. Increased turbidity around the borrow site and placement sites may affect sensitive benthic habitats such as oyster reefs, coral reefs, and seagrasses (Michel et al. 2013). However, best practices, such as silt curtains, buffer zones, and water quality monitoring, would be used to minimize such effects. Adjacent benthic populations would be expected to move into the borrow site and recolonize quickly, within one to three years (Greene 2002).

Sea turtles and marine mammals present in project areas where dredging or underwater use of equipment is occurring could be adversely affected by temporary increases in noise and turbidity, water quality changes, alteration or loss of habitats, entrapment, and potential interactions with dredging equipment.

Potential short-term, minor adverse effects of this approach could include disturbance to marine mammals, sea turtles, and birds in nearshore waters from increased vessel traffic. Vessel collisions contribute to the anthropogenic mortality of several threatened marine species including turtles, manatees, and whales (Hazel et al. 2007; Kraus et al. 2005) and there is a possibility of vessel strikes to sea turtles and marine mammals from increased vessel activity. To prevent vessel collisions and noise impacts to marine mammals and sea turtles during dredging and vessel operations, other best practices (including shutting down dredge pumps, restricting vessel speeds, placing vessels in neutral in the presence of the animals, and moving away when animals are observed within specific distances of the vessel) are usually required (NMFS & FWS 2008). Barrier and coastal island and headland restoration and creation activities can result in short-term impacts to shorebirds from disturbance and reduced foraging efficiency if the birds are roosting and feeding in the area during a migration stopover. These activities could also result in harm or mortality if birds are nesting in the area. For example, the deposition of sand will temporarily deplete the intertidal food base during construction and for six months to two years following construction, depending on invertebrate faunal recovery rates (summarized in (Bejarano et al. 2011) If disturbance or reduced foraging efficiency persists, birds may be temporarily displaced (Peterson et al. 2006), resulting in valuable energy reserve expenditures to seek available habitat elsewhere. Nourished beaches can negatively affect sea turtle nesting if the sand is too hard for the turtles to dig nests or if the composition and properties of the sand is different and reduces egg survival. However, all projects may include implementation of best practices to minimize or avoid any potential negative consequences. For example, sediment placement on shorelines to enhance or create nesting bird or sea turtle habitat would be scheduled to avoid disturbances during nesting season, and monitors would be used to avoid harm and mortality and minimize other effects.

Restoration efforts that increase stability and resilience of barrier and coastal islands may result in long-term habitat benefits, including increased areal extent and improvement of beach habitat for beach mice, foraging birds, nesting bird colonies, and sea turtle nesting. For example, barrier islands and headlands along the central Gulf Coast provide habitat for the federally protected piping plover, and expanding the potential nesting habitat for these beach-nesting birds could directly benefit the

population. Restored barrier and coastal islands and headlands could benefit interior freshwater wetland habitats, back-bay seagrass and oyster reefs, and coastal and riparian areas by reducing erosion, scouring, and subsequent water quality impacts of storm surge events.

6.4.1.3.3 Socioeconomic Resources

Area closures are anticipated during construction to protect public safety and may result in short-term limits to tourism and recreational uses. If these closures occur in areas with high levels of hunting, fishing, and tourist activity, resource users may choose to pursue these recreational activities in different locations or forgo the activity. Adverse impacts to tourism and recreation resulting from potential closures would be expected to be short-term and minor to moderate. Over the long term, these projects could provide wildlife enthusiasts with increased wildlife viewing opportunities. Long-term benefits for the public are anticipated as a result of the restoration approach.

Impacts to cultural resources resulting from the implementation of this restoration technique are dependent on site-specific conditions associated with a proposed project. Creating, enhancing, or restoring barrier and coastal wetlands and headlands could result in minor (temporary disturbance) to moderate (disturbance without loss of cultural information) impacts on cultural and historic resources due to construction activities such as dredging, addition of sediments or borrow materials, and/or removal of sediments. Adverse impacts could include physical destruction or alteration of resources and may alter, damage, or destroy resources such as historic shipwrecks, engineering structures or landscapes, or connectivity with related sites. The AWOIS database and other relevant studies are available for identification of submersed resources for individual projects. Discovery or recovery of cultural or historic resources would allow the future protection of the resource.

Projects will be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

Barrier island restoration projects generally result in beneficial impacts on human use of those areas. In particular, wide beaches with healthy dunes may draw additional visitors to the area, with associated increases in visitor spending and sales and tax receipts. Short-term benefits to the local economy could accrue through an increase in employment and associated spending in the project area during construction activities. Project construction spending would support the workforce needed to design, engineer, manage, and carry out the project. Additionally, there would be socioeconomic benefits from improved shoreline integrity and additional buffer and flood storage during storms.

6.4.1.4 Restore and Enhance Dunes and Beaches

This restoration approach focuses on restoring dunes and beaches through various techniques that provide important habitat for many animal and plant species including, but not limited to, sea turtles, birds, and endangered beach mice, and are important to coastal stability and ecology in the Gulf of Mexico. The approach will also serve to restore popular recreational areas for local visitors and tourists. Dunes are also sand storage areas that supply sand to eroded beaches. Because dunes have been heavily affected by development and storm activity, this habitat is often unavailable as a natural source of sand for beaches. A variety of restoration techniques are available for use, individually, or in combination, as potential restoration projects. Multiple restoration techniques are available for use

individually, or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Renourish beaches through sediment addition.
- Restore dune and beach systems through the use of passive techniques to trap sand.
- Plant vegetation on dunes.
- Construct groins and breakwaters or use sediment bypass methods.
- Protect dunes systems through use of access control.

6.4.1.4.1 Physical Resources

Construction associated with beach renourishment can result in direct, short-term adverse impacts to geology, substrates, and water quality from sediment handling at both the borrow site (sediment source) and the placement site and soil and substrate disturbance during dune vegetation plantings. Construction of hard structures such as groins, breakwaters, and living shorelines can involve the use of heavy equipment on the shoreline and/or barges that can cause direct, localized, and short-term adverse impacts to sediments (e.g., disturbance and compaction), water quality (e.g., increased turbidity), air quality (due to vehicle emissions), and ambient noise conditions as the materials are placed in the designed configuration. These structures will permanently cover existing substrates and geology. One concern with hard structures on beaches, if not properly designed, is that they can cause erosion of the downdrift shoreline and scour on the seaward end. Once in place, structures such as groins and breakwaters can change the natural process of sediment accretion and erosion, including preventing washover events on beaches and causing erosion in offsite locations. These adverse effects would be minor to moderate and long-term, because they could affect substrate and geologic characteristics of the adjacent shoreline, and these effects will extend beyond the construction period. Sediment bypassing methods could have minor and short-term adverse impacts at the placement site (e.g., erosion), however, these potential impacts can be addressed by appropriate design and engineering techniques However, best practices, such as silt curtains, buffer zones, and water quality monitoring, would be used to minimize such effects. Local noise levels would increase temporarily, and minor to major adverse impacts from noise may occur during construction. The severity of these physical impacts is expected to be minor to major and would depend to a large degree on the location of the project, the amount of disturbance that these activities would generate, and the distance to sensitive receptors such as recreational users or wildlife.

However, long-term beneficial impacts would be expected because beach and dune restoration can protect the coastline from sea level rise and reduce shoreline erosion, as described previously.

6.4.1.4.2 Biological Resources

Direct, short-term adverse impacts to benthic habitats during beach nourishment may occur due to temporary placement of pipelines (for transport of sediments), temporary storage of dredged sediments in nearshore habitats, and final placement of sediment in the footprint where existing habitats would be covered by additional sediment. Increased turbidity around the borrow site and placement sites may affect sensitive benthic habitats such as oyster reefs, coral reefs, and seagrasses (Michel et al. 2013). However, best practices such as silt curtains, buffer zones, and water quality monitoring, would be used to minimize such effects. Adjacent benthic populations would be expected to move into the borrow site and recolonize quickly, within one to three years (Greene 2002).

Beach habitats contribute to the quantity and quality of adjacent shallow water habitats that serve as nurseries or forage areas for some finfish species. The beach-shallow water interface also provides nutrient exchange to aquatic habitats. Protecting these habitats could result in a long-term benefit to these species and indirectly benefit the food chain that relies on the health of adjacent shallow water areas.

Sea turtles and marine mammals present in project areas where dredging or underwater use of equipment is occurring could be adversely affected by temporary increases in noise and turbidity, water quality changes, alteration or loss of habitats, entrapment, and potential interactions with dredging equipment. Groin and breakwater construction could result in minor to moderate, long-term adverse impacts to access to nesting beaches for sea turtles and navigation/survival of hatchlings leaving nesting beaches.

Potential minor adverse effects of this approach could include disturbance to marine mammals, sea turtles, and birds in nearshore waters from increased vessel traffic, as described earlier in Section 6.4.1.3, Create, Restore, and Enhance Barrier and Coastal Islands and Headlands.

Restoration efforts that increase stability and resilience of dunes and beaches may result in long-term habitat benefits, including increased areal extent and improvement of beach habitat for beach mice, foraging birds, nesting bird colonies, and sea turtle nesting. For example, beaches along the central Gulf Coast provide habitat for the federally protected piping plover, and expanding the potential nesting habitat for these beach-nesting birds could directly benefit the population. Restored beaches and dunes could benefit back-bay seagrass and oyster reefs by reducing erosion, scouring, and subsequent water quality impacts of storm surge events.

The footprint of hard structures such as groins, breakwaters, and living shorelines changes the habitat from a soft to hard substrate, which changes the benthic community, often adding habitat complexity and attracting new species of attached organisms such as oysters and algae and the animals that feed on them, such as birds, fish, and sea turtles (Bulleri & Chapman 2010).

6.4.1.4.3 Socioeconomic Resources

Area closures are anticipated during construction to protect public safety and may result in short-term adverse impacts associated with limits to tourism and recreational uses accessibility and opportunities in localized areas. If these closures occur in areas with high levels of hunting, fishing, and tourist activity, resource users may choose to pursue these recreational activities in different locations, or forgo the activity. Adverse impacts to tourism and recreation resulting from potential closures would be expected to be short-term.

Socioeconomic impacts of beach restoration projects are generally positive. Wide beaches with healthy dunes may draw additional visitors to the area, with associated increases in visitor spending and sales and tax receipts. Short-term benefits to the local economy could accrue through an increase in employment and associated spending in the project area during construction activities. Socioeconomic benefits would also result from improved shoreline integrity and additional buffer and flood storage during storms.

If cultural or historic resources are present, minor to moderate adverse impacts to the resource would be anticipated during construction activities such as dredging and placement/removal of sediments or other materials used during the restoration of dunes and beach. Adverse impacts could include physical destruction or alteration of all or part of a cultural or historic resource and may directly alter, damage, or destroy resources such as historic shipwrecks, engineering structures or landscapes, or connectivity with related sites. The AWOIS database and other relevant studies would be consulted in the identification of resources to evaluate potential impacts for individual projects. Discovery or recovery of cultural or historic resources would allow the future protection of the resource.

6.4.1.5 Protect and Conserve Marine, Coastal, Estuarine, and Riparian Habitats

This restoration approach supports, protects, and restores a wide variety of coastal, estuarine, and riparian habitats and the ecosystem services they provide, through the identification, protection, management, and restoration of important habitat areas or land parcels. Areas may be identified for conservation based on their potential for loss or degradation, ability to protect or buffer wetlands or allow for habitat migration over time, contributions to restoring ecosystems and significant coastal habitats, ability to connect protected areas, and/or ability to reduce coastal water pollution. There are multiple restoration techniques that can be used individually, or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Acquire lands for conservation.
- Develop and implement management actions in conservation areas and/or restoration projects.
- Establish or expand protections for marine areas.

6.4.1.5.1 Physical Resources

Specific restoration activities identified as part of land management plans could result in short-term, minor to moderate adverse effects to geology, substrates, and water resources. The intensity of impacts would strongly depend on the management goals for the acquired land and the location of the project. For example, fire management, predator control, and vegetation planting may have short term adverse impacts to soils, substrates, and air quality. Land acquisition could permit public access for recreational use. For example, marine protected areas (MPAs) are put in place to help maintain essential ecological processes, preserve genetic diversity, and ensure the sustainable use of species and ecosystems (Kelleher 1999) but do not generally preclude public access. This public use, which would depend on management stipulations developed as part of the land acquisition, could result in short-term, minor to moderate adverse effects through increased soil compaction, rutting, or erosion caused by human presence and activity within the conservation area. Increased public use could result in short-term, minor effects to surface water through increased sedimentation and turbidity caused by human presence and activity within wetland/shallow water habitat.

During implementation of land management plans and/or establishment/expansion of marine protection areas there could be short-term, minor to moderate adverse impacts to air quality from emissions generated by construction equipment and vehicles. Impacts during establishment of marine protection areas would be short-term and minor and likely a result of adding signs, buoys, and other infrastructure to identify the protection areas. The severity of impacts would highly depend on the length and type of construction required and the location of the project. Construction activities are anticipated to result in temporary minor to moderate adverse impacts to air quality due to pollutants

from fuel emissions, including particulate matter, lead, and carbon monoxide GHGs are specifically addressed in Section 6.14.1, Impacts of Restoration Approaches on GHG Emissions).

Depending on the land use following acquisition, some changes in noise levels could occur; however, these would be evaluated on a project-specific basis (e.g., public access might result in minor increases to noise levels from recreational users, or preservation of lands may help to maintain natural quiet over a longer term). During implementation of the land management plan, minor, short- and long-term adverse impacts to ambient noise levels could occur. The severity of impacts would depend to a large degree on the location of the project, the amount of noise that these activities would generate, and the proximity of sensitive noise receptors, including wildlife, to these activities.

Fee title land acquisition or use of a conservation easement could reduce disturbance of geology and substrates by protecting lands from development pressure. This would be a long-term beneficial effect that will extend the life of the project. Where easements and protected lands overlap groundwater recharge zones, surface water, or brackish-water resources, water sources and quality could be further protected from future degradation by helping to reduce runoff. Similarly, where protected land overlaps wetlands or shorelines, the protection of natural hydrologic processes could indirectly help limit development and associated effects on water quality, including via saltwater intrusion. These would be long-term beneficial effects.

6.4.1.5.2 Biological Resources

Specific restoration activities identified as part of land management plans could result in short-term, minor to moderate adverse effects to conservation areas. The severity of impacts would be highly dependent on the management goals for the acquired land and the location of the project. Construction activities that may occur on conserved lands may result in introduction of invasive species. Use of best practices would help prevent the introduction of invasive species. However, if invasive species became established in, or adjacent to, restored or enhanced habitats areas, this adverse effect would be short- to long-term, would be limited to the local area, and may range from minor to moderate.

Removal of non-native/invasive plants benefits certain species as part of land management plans; however, there can be negative impacts on other ecosystem components if removal methods are too intensive (Zarnetske et al. 2010). Timing of removal actions would be scheduled to minimize disturbance to sensitive nontarget species. In addition, lethal predator control methods intentionally have direct effects on the targeted species, but such actions are taken only after careful technical evaluation and environmental assessment. Unintentional mortality of nontarget organisms and native species targeted for protection from predators could occur through the use of broadcast baits such as those used for rat removal. Aerial dispersal of baits containing rodenticides can cause direct mortality to foraging and scavenging animals (such as gulls and small mammals) that ingest bait pellets (EPA 2004). Exposure of nontarget organisms is generally reduced by the short life cycle of the chemicals used; however, additional application to remove predators may be necessary over time and could result in repeated impacts to those nontarget species at most risk.

Implementation of land management plans, located within or near restoration activities, could result in disturbed, removed, or altered habitats, which could cause minor to moderate, short- and long-term adverse effects to species that use those habitats for forage or nesting purposes. The severity of impacts would highly depend on the management goals for the acquired land and the location of the project. For

example, land acquisition could permit public access for recreational use. This public use, depending on management stipulations, could result in long-term, minor to moderate adverse effects to area species through increased human presence and activity on acquired habitats.

Conservation of habitat through fee title acquisition, use restrictions, and improved management could have a long-term benefit to any habitat on the property acquired or protected. Conservation would also allow for upland migration of beach, wetland, or other habitats as the sea level rises and could limit development encroachment. Conservation of habitat through fee title acquisition or conservation easements could have a long-term benefit to fish, sea turtles, marine mammals, birds, and terrestrial wildlife through the protection of coastal, riparian, or terrestrial habitat. These habitats can be important for food supply and various life stages of some species. These benefits would depend on project-specific goals and the location of acquired land. Establishment or expansion of marine protection areas would increase the ability to manage, conserve, and protect marine species.

6.4.1.5.3 Socioeconomic Resources

This approach could have long-term, minor to moderate adverse economic effects if conservation easement or acquisition prevents or limits development.

Preserving habitat by acquisition of property or through conservation easements could permanently limit the amount and type of development permitted, and the management and intensity of use on these properties would likely change. Land conservation or acquisition may result in restrictions on public access in areas where public access had previously been allowed, which could reduce recreational opportunities. Projects that result in changes in ownership and/or permitted uses could affect property taxes and have broader regional economic impacts resulting from changes in visitor spending in the region. Land acquisition could have a minor to moderate impact on socioeconomic resources due to changes in visitor spending and tax impacts. The transfer of fee title to lands and the creation of conservation easements, however, are transactions negotiated or arranged between willing parties and, as such, are not expected to give rise to adverse socioeconomic impacts to those who choose to engage in such transactions.

The acquisition of lands to protect habitat could result in impacts to recreation and tourism opportunities depending on site-specific land management practices applied. Closures, such as fencing or other mechanisms to protect nest sites, could result in short-term (seasonal) prohibitions on public access. Restrictions on public access in areas where public access had previously been allowed could reduce recreational opportunities.

Over the long term, these techniques could result in healthy populations and provide wildlife enthusiasts with increased wildlife viewing opportunities. Conservation or acquisition of natural land resources can have indirect benefits on fish and wildlife habitat, potentially resulting in increased fishing and hunting opportunities. Seasonal or permanent employment could increase in order to provide labor for the installation, maintenance, and implementation of management projects such as hunting or trapping.

Changes to land use resulting from land acquisition could change access to natural resources (e.g., restricted access for different types of uses when under private ownership) and change the future

development of infrastructure or services. Depending on the type and location of the project, these implications could have an adverse or a beneficial impact on socioeconomic characteristics.

For example, if private lands are opened for recreational use, this could be beneficial. These benefits would result from improved aesthetics and opportunities to view, catch, or hunt wildlife either on the protected lands, if allowed, or in nearby areas that are likely to experience improved abundance and diversity of species as a result of the spillover effects of conservation efforts.

Further, the acquisition of coastal land for conservation easements could mitigate some of the economic impacts of expected sea level rise by preventing development that would be at risk from future storm surges or flooding. Social and economic impacts would be site-specific and would depend on what resources were protected or enhanced; the potential for use and enjoyment by residents, businesses, and visitors; and whether conservation efforts supported or conflicted with community goals.

Impacts to cultural resources and infrastructure resulting from the implementation of a conservation action or habitat management plan would depend on site-specific conditions associated with a project proposed for implementation. For example, benefits to cultural resources and infrastructure could result if conservation includes protecting cultural or infrastructure resources that are within or close to protected areas.

6.4.2 Restoration Type: Habitat Projects on Federally Managed Lands

This restoration type comprises many of the same restoration approaches proposed for many of the other restoration types. Rather than repeat the NEPA analyses here, we refer the reader to the sections in this chapter where the pertinent restoration types/approaches are analyzed.

- **Create, restore, and enhance coastal wetlands.** Potential techniques include but are not limited to creating or enhancing coastal wetlands through placement of dredged material, backfilling canals, restoring hydrologic connections to enhance coastal habitats, and constructing breakwaters. The programmatic NEPA analysis is found in Section 6.4.1.1.
- **Restore oyster reef habitat.** Potential techniques include but are not limited to restoring or creating oyster reefs by placing cultch in nearshore intertidal and subtidal areas, constructing living shorelines, and enhancing oyster reef productivity through spawning stock enhancement projects. The programmatic NEPA analysis is found in Section 6.4.12.
- **Create, restore, and enhance barrier and coastal islands and headlands.** Potential techniques include but are not limited to removing or constructing barrier and coastal islands and headlands via placement of dredged sediments and planting vegetation on dunes and back-barrier marsh. The programmatic NEPA analysis is found in Section 6.4.1.3.
- **Restore and enhance dunes and beaches.** Potential techniques include but are not limited to renourishing beaches through sediment addition, restoring dune and beach systems through the use of passive techniques to trap sand, planting vegetation on dunes, constructing groins and breakwaters or using sediment bypass methods, and protecting dune systems through use of access control. The programmatic NEPA analysis is found in Section 6.4.1.4.

- **Restore and enhance SAV.** Potential techniques include but are not limited to backfilling scars with sediment; revegetating beds via transplant and/or propagation; enhancing beds through nutrient addition; and protecting beds with buoys, signage, and other protective measures. The programmatic NEPA analysis is found in Section 6.4.8.

- **Protect and conserve marine, coastal, estuarine, and riparian habitats.** Potential techniques include, but are not limited to fee title acquisition; property use restrictions and/or management; and conserving, managing, and restoring habitat that is being acquired or is currently under protection. The programmatic NEPA analysis is found in Section 6.4.1.5.

- **Promote environmental stewardship, education, and outreach.** Potential techniques include but are not limited to creating or enhancing natural-resource-related educational materials and/or programs to reduce visitor impacts to habitat. The programmatic NEPA analysis is found in Section 6.4.13.3.

- **Restore SAV.** Potential techniques include but are not limited to backfilling scars with sediment; revegetating beds via transplant and/or propagation; enhancing beds through nutrient addition; and protecting beds with buoys, signage, and other protective measures. The programmatic NEPA analysis is found in Section 6.4.7.7, Reduce Injury and Mortality of Sea Turtles from Vessel Strikes.

6.4.3 Restoration Type: Nutrient Reduction (Nonpoint Source)

The nutrient reduction and water quality restoration types address impacts to water quality. This section is specific to nutrient reduction (nonpoint source). The restoration approaches associated with this restoration type are as follows:

- Reduce nutrient loads to coastal watersheds.

- Reduce pollution and hydrologic degradation to coastal watersheds (see Section 6.4.4.1 under the restoration type Water Quality).

- Create, restore, and enhance coastal wetlands (See Section 6.4.1.1 under the restoration type Wetlands, Coastal, and Nearshore Habitats).

- Protect and conserve marine, coastal, estuarine, and riparian habitats. (See Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats).

The restoration approach is to reduce nutrient loads to coastal watersheds by reducing runoff from agricultural areas. The following sections describe the environmental consequences of this approach.

6.4.3.1 Reduce Nutrient Loads to Coastal Watersheds

This restoration approach would implement conservation practices in vulnerable areas to reduce nutrient pollution and provide ecosystem-scale benefits to Gulf Coast habitats and resources chronically threatened by nutrients and co-pollutants causing water quality degradation. Projects will be targeted in areas on public or private lands to reduce nutrient losses from the landscape and reduce loads to streams and downstream receiving waters and, thus, provide benefits to coastal waters that have

degraded water quality (e.g., hypoxia and harmful algal blooms). As such, this approach would require the voluntary cooperation and support of partners that may include, but are not limited to, private landowners and farmers; timber management/logging operations; municipal and county governments; and appropriate local, state, and federal agencies. Where feasible, these projects should be coordinated within watershed boundaries to enhance nutrient reductions to coastal water bodies. Examples of past successful water quality restoration projects include regional watershed management plans, state Clean Water Act 319 programs, and USDA-NRCS conservation programs (i.e., Environmental Quality Incentives Program [EQIP], Conservation Reserve Program [CRP], Wetlands Reserve Program [WRP], Wildlife Habitat Incentives Program [WHIP]). This funding will not be used to fund previous activities required under local, state, or federal law (e.g., pollution reduction actions required by a Clean Water Act permit), but instead could be used in coordination with existing mandates to enhance water quality benefits. Through a coordinated and integrated watershed approach to project implementation, expected benefits include reductions in nutrient losses from the landscape; reductions in nutrient loads to streams and downstream receiving waters; reduction in water quality degradation (e.g., hypoxia and harmful algal blooms); and associated benefits to coastal waters, habitats, and resources.

6.4.3.1.1 Physical Resources

Some agricultural best practices include small-scale construction projects (e.g., to manage manure and runoff from feedlots). Therefore, during construction, short-term, minor adverse impacts on geology, substrate, hydrology, surface and ground water quality (e.g., nutrients, fertilizers, pesticides, total suspended solids in runoff, and high conductivity groundwater), air quality, and noise (due to emissions) would be anticipated. However, long-term benefits are expected to result because these conservation practices to reduce nutrients would slow erosion, stabilize soils, improve water quality, and increase groundwater recharge.

6.4.3.1.2 Biological Resources

Depending on the projects implemented, short-term, minor adverse impacts may be anticipated during construction. For example, if construction includes earth-moving work, terrestrial vegetation may be disturbed. Benefits to biological resources such as benthic invertebrates, shellfish, finfish, and marine mammals could result from 1) improved water quality in the watershed and associated estuary and 2) reduced contaminant loadings (e.g., pesticides and fuel contaminants such as polyaromatic hydrocarbons (PAHs) and metals).

6.4.3.1.3 Socioeconomic Resources

Impacts to socioeconomics resulting from the implementation of this restoration approach are dependent on site-specific conditions associated with a project proposed for implementation. Depending on the techniques employed, short-term benefits to the local economy could accrue through an increase in employment and associated spending in the project area during construction activities. Improvements to water quality could result in indirect benefits to recreational activities and commercial fishing. If cultural or historic resources are present, minor adverse impacts to the resource would be anticipated during construction activities such as dredging and placement/removal of sediments or other materials.

6.4.4 Restoration Type: Water Quality (e.g., Stormwater Treatments, Hydrologic Restoration, Reduction of Sedimentation, etc.)

The nutrient reduction and water quality restoration types address impacts to water quality. This section is specific to water quality (stormwater treatments, hydrologic restoration, reduction of sedimentation, etc.). The restoration approaches associated with this restoration type are as follows:

- Reduce pollution and hydrologic degradation to coastal watersheds.
- Reduce nutrient loads to coastal watersheds (see Section 6.4.3.1 under the restoration type Nutrient Reduction [Nonpoint Source]).
- Create, restore, and enhance coastal wetlands (See Section 6.4.1.1 under the restoration type Wetlands, Coastal, and Nearshore Habitats).
- Protect and conserve marine, coastal, estuarine, and riparian habitats. (See Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats).

The restoration approach to reduce pollution and hydrologic degradation to coastal watersheds is described below.

6.4.4.1 Reduce Pollution and Hydrologic Degradation to Coastal Watersheds

This restoration approach focuses on restoring hydrology and reducing pollution in coastal watersheds to improve local water quality and provide benefits to nearshore Gulf Coast ecosystems. Development in coastal watersheds leads to hydrologic alterations that change the volume, timing, duration, and quality of freshwater inflow in the form of increased stormwater runoff and hydrologic restrictions. These alterations in freshwater inflows are also correlated with increased flooding and discharge of pollutants, including fecal bacteria and pathogens, to nearby coastal water bodies.

Stormwater runoff is the most common and ubiquitous source of nonpoint source pollution in the coastal landscape. It is created when rainfall flows over natural landscape or impervious surfaces and does not percolate into the ground. Coastal development is associated with impervious surface cover (e.g., roads, rooftops, parking lots, and driveways), which increases the volume and rate of stormwater runoff (EPA 2003). Stormwater runoff accumulates debris, sediment, and pollutants (e.g., chemicals, fertilizers, herbicides, insecticides, salts, oil, and bacteria and solids from livestock, pets, and faulty septic systems) throughout the landscape and discharges them into nearby coastal waters. This discharge can impair water quality in both local waterways and downstream coastal Gulf waters (EPA 2003). The U.S. Environmental Protection Agency (EPA) and the states regulate and permit certain pollutant sources; however, strategic enhancements in pollution reduction techniques could provide a reduction in pollution of nearby coastal waters.

This restoration approach would implement a combination of stormwater control measures, erosion control practices, agriculture conservation practices, forestry management practices, hydrologic restoration, and coastal and riparian conservation techniques that are not previously mandated by the Clean Water Act. This restoration approach could implement, but is not limited to, the following techniques:

- Implement low-impact development (LID) practices.
- Implement traditional stormwater control measures (SCM).
- Implement erosion and sediment control (ESC) practices.

6.4.4.1.1 Physical Resources

Depending on the project type, there could be short-term, minor adverse impacts on geology, substrate, hydrology, water quality, air quality, and noise during the construction phase. However, short-term adverse impacts would be minimized by implementing best practices. Short-term, minor impacts to air quality and ambient noise levels are anticipated as a result of construction emissions. Long-term benefits to surface water and groundwater are anticipated as a result of reduced total suspended solids, nutrients, and other contaminant loads in stormwater runoff and increases in pervious areas that concomitantly increase groundwater recharge.

6.4.4.1.2 Biological Resources

Depending on the techniques employed, short-term, minor adverse impacts may be anticipated during construction. For example, if construction includes earthmoving work, terrestrial vegetation may be disturbed. Benefits to biological resources, such as benthic invertebrates, shellfish, finfish, and marine mammals, and SAV could result from improved water quality in the watershed and associated estuary from reduced contaminant loadings (e.g., pesticides and fuel contaminants).

6.4.4.1.3 Socioeconomic Resources

Impacts on socioeconomic resources resulting from the implementation of this restoration approach would depend on site-specific conditions associated with a project proposed for implementation. Upgrades or maintenance of infrastructure could result in minor, short- and long-term economic impacts related to funding of these efforts. Depending on the projects implemented, short-term benefits to the local economy could accrue through an increase in employment and associated spending in the project area during construction activities. Improvements to water quality could result in indirect benefits to recreational activities and commercial fishing. Projects that are anticipated to enhance stormwater infrastructure would be expected to result in improved public health and safety as a result of improved runoff controls and reduced stormwater flooding that may otherwise flood streets and interfere with utilities, including storm sewers and wastewater facilities.

6.4.5 Restoration Type: Fish and Water Column Invertebrates

The following restoration approaches are proposed under the restoration type Fish and Water Column Invertebrates:

- Gear conversion and/or removal of derelict fishing gear to reduce impacts of ghost fishing.
- Reducing mortality among Highly Migratory Species and other oceanic fishes.
- Voluntary reduction in the Gulf menhaden harvest.
- Incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship.

- Enhance development of bycatch-reducing technologies.
- Reduce post-release mortality of red snapper and other reef fishes in the Gulf of Mexico recreational fishery using fish descender devices.
- Reduce Gulf of Mexico commercial red snapper and other reef fish discards through the IFQ[7] allocation subsidy program.

The following sections describe the environmental consequences of these approaches.

6.4.5.1 Gear Conversion and/or Removal of Derelict Fishing Gear to Reduce Impacts of Ghost Fishing

This restoration approach focuses on reducing the amount of ghost fishing by derelict fishing gear, either by removing gear from coastal environments when it has been lost and/or by modifying (converting) gear so that when it is lost it is less likely to cause bycatch mortality. Marine debris is one of the most widespread pollution problems facing ocean and coastal environments worldwide (IMDCC 2014; NAS 2009). In the United States, the U.S. Congress defines marine debris as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned in the marine environment or Great Lakes (33 USC § 1951 *et seq*., as amended). One of the most persistent and damaging types of marine debris is lost or derelict fishing gear (Macfadyen et al. 2009), which continues to catch organisms after the gear is lost, a phenomenon known as “ghost fishing.” Ghost fishing from derelict fishing gear is a potentially significant source of mortality for fish and other organisms (Arthur et al. 2014; Macfadyen et al. 2009). Derelict blue crab traps are a potential target for restoration because they are present in high numbers in the Gulf, are documented to catch estuarine-dependent finfish and invertebrate species, and are relatively easy to find in both intertidal and subtidal waters. Research indicates that traps 1) are lost due to many factors, some of which are preventable, 2) persist in the environment for several years, and 3) nondiscriminately catch target and nontarget species (Arthur et al. 2014; Bilkovic et al. 2014; Clark et al. 2012; Guillory 1993; Havens et al. 2008). Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Implement contract and volunteer removal programs to collect existing derelict fishing gear.
- Conduct voluntary gear conversion programs.

6.4.5.1.1 Physical Resources

Gear removal may result in minor, short-term adverse impacts on the physical environment from disturbance to existing substrates from gear removal devices. There may be short-term, minor adverse impacts to air quality, water quality, and benthos during assessment surveys, transport during removal events, and actual gear removals, which will require the use of vessels. The impacts associated with this activity are expected to be short-term and minor. Adverse impacts to physical resources are anticipated to be minor.

[7] IFQ = individual fishing quota

Beneficial impacts may occur to the physical environment due to removal and reduction of derelict fishing gear. For example, long-term benefits are expected due to decreased movement of derelict crab traps on the seafloor, which may disturb benthic substrates. The proposed restoration would result in a reduction in persistent synthetics (plastics) in the environment that provide a mechanism for accumulation of organic toxins such as polychlorinated biphenyls (PCBs) (Van et al. 2012). Marine debris in general also provides a means of transporting invasive species to additional locations. Reductions in marine debris will lead to long-term, minor improvements in water quality.

6.4.5.1.2 Biological Resources

Short-term, minor adverse impacts to biological resources may occur as a result of gear removal activities, such as disturbance of sediments and vegetation.

Beneficial impacts are expected to biological resources due to removal and reduction of derelict fishing gear. Long-term benefits will accrue due to habitat improvement through reduced trap movement on benthic sediments (Uhrin et al. 2014); reductions in marine mammal, sea turtle, and diving seabird entanglement in the buoy line (Gilardi et al. 2010); and enhanced crab and finfish resources due to decreases in ghost fishing.

6.4.5.1.3 Socioeconomic Resources

Because participation in this approach would be voluntary, adverse economic impacts associated with participating are not anticipated. The gear conversion program would provide incentives for the voluntary use of technological innovations, while the gear removal program would provide incentives for assistance with derelict trap survey and removal operations.

Debris removal could result in long-term, beneficial socioeconomic impacts. Marine debris can result in beach closures, which can have particularly serious economic ramifications in coastal areas dependent upon tourism (Oigman-Pszczol & Creed 2007). Marine debris has the potential to disable vessels via direct interactions with the debris or propeller/intake interactions, which can result in economic costs (USCOP 2004). Marine debris can also damage fisheries habitat (NOAA 2011b) and can interfere with navigational safety because it can be difficult to see and avoid (NAS 2009). These types of encounters with marine debris at sea can result in costly damage to a vessel such as a tangled propeller or clogged intake (NOAA 2011b). Removal of derelict traps is expected to result in an indirect beneficial impact to both commercial and recreational boater safety due to reduced entanglement hazards to boat propellers.

No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.5.2 Reduce Mortality Among Highly Migratory Species and Other Oceanic Fishes

Highly migratory species and other oceanic fishes, including tunas, billfishes, sharks and swordfish, transit large expanses of the world's oceans in search of desirable habitat, such as foraging or spawning grounds. In doing so, they move between jurisdictional boundaries. These species are threatened by the substantial mortality associated with bycatch (catch of nontarget species) within the commercial pelagic longline (PLL) fishery and post-release mortality in recreational rod and reel (RR) fisheries. The PLL

fishery in the Atlantic (which includes the Gulf of Mexico and Caribbean) primarily targets yellowfin tuna, bigeye tuna, and swordfish. Incidentally caught species include bluefin tuna, billfish, and sharks. Regulations, fishing practices, and bycatch mortality vary substantially by country and geography. This restoration approach aims to reduce bycatch-related mortality to Highly Migratory Species and other oceanic fish by encouraging fishers to convert to fishing gear that can exclude, or reduce harm to, nontarget species, including those considered undersized (i.e., not retained because of regulatory limits). Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Promote gear conversion to circle hooks and weak hooks.
- Promote gear conversion to greenstick and buoy gear.
- Implement incentive-based annual time closure (repose period).

6.4.5.2.1 Physical Resources

This approach could result in short-term beneficial impacts to air quality if the pelagic longline fishing repose (period of inactivity) results in slightly reduced fishing hours and vessel use. Other techniques for this approach, such as the use of weak hooks or circle hooks, could increase vessel operation time if additional time is required to catch fishing quotas. Expected possible small shifts in the number and behavior of vessels may result in subtle changes in noise levels and air quality from those associated with the current operations in the PLL fishery. Vessel operations are anticipated to result in short-term, minor adverse impacts to air quality due to pollutants from fuel emissions, including particulate matter, lead, and carbon monoxide (GHGs are specifically addressed in Section 6.14.1). The impacts associated with this restoration approach are expected to be short-term.

6.4.5.2.2 Biological Resources

This approach could result in an increase in the catch of certain nontarget species as a result of the conversion to a different gear in the PLL fishery. This could result in minor to moderate, adverse, long-term impacts to those species. For example, many Highly Migratory Species of sharks have higher catch rate with circle hooks (Afonso et al. 2012).

The use of circle hooks and weak hooks has been found to reduce discard mortality and bycatch among numerous species; thus, replacing traditional J-hooks with these alternative hook types would have long-term benefits to highly migratory species and other pelagic ocean fishes (Serafy et al. 2012-a; Serafy et al. 2012-b). This approach is expected to reduce catch of large bluefin tuna (via weak circle hooks) by recreational fishers and reduce bycatch mortality of bluefin tuna and other nontarget species (via circle hooks) in the pelagic longline fishery. Although the proposed approach will not necessarily reduce the total number of bluefin caught recreationally, since they are managed under an individual bluefin tuna fishing quota system, the number of bluefin tuna caught during spawning and high migration intensity in the Atlantic Ocean will be reduced. The use of low-bycatch gear is expected to have a positive impact numerous species in the Atlantic and Gulf of Mexico ecosystem that are caught as bycatch in pelagic longline gear. The reduction in discards and discard and post-release mortality anticipated as a result of this approach would also allow more Highly Migratory Species and other oceanic fish to survive and, thus, continue to grow and/or reproduce.

Protected species that may also benefit from the proposed techniques include sea turtles, marine mammals, and seabirds. Dolphins and whales interact with longline fishing gear. Sea turtles can ingest the hooks of longline fishing gear, become entangled in the lines, or be hooked externally. Seabird interactions occur in the longline fishery, but at relatively low levels and these interactions mainly occur when gear is being set and birds attempt to pull bait off the hooks. To the extent that this approach results in reduced fishing activities, reductions in protected species interactions with longline gear should also decrease.

6.4.5.2.3 Socioeconomic Resources

This approach could have minor to moderate, short-term adverse impacts on the commercial fishing industry in the Gulf of Mexico as a result of reduced fishing effort and income or price of harvested fish. However, the long-term benefits include reduced fishing pressure on species such as bluefin tuna and other nontargeted species, providing a mechanism for population and fishery recovery and eventual quota increases. Reducing bycatch can result in an increase in fish biomass that could in turn result an increased catch or fishing opportunities. This can result in an economic benefit to commercial and recreational fishers. The scale of these impacts will depend on the specific techniques implemented and the resulting changes to fish quality and harvest levels. However, vessel captains and crews could continue to receive salaries; fish dealers may experience fewer disruptions in fish supplies than might occur if no fishing occurred; fuel suppliers may continue to sell fuel to vessels participating in the PLL repose; and ice, bait, and equipment suppliers may not see as much of a change in sales as if no fishing occurred.

There is anecdotal feedback that the National Marine Fisheries Service (NMFS) received from dealers that indicates the use of alternative gear types may affect fish quality, which could affect ex-vessel prices (prices fishers receive for catch at the point of landing). Decreased prices would result in less profit for fishers, which could result in lower spending by participants in this approach.

No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.5.3 Voluntary Reduction in the Gulf Menhaden Harvest

This restoration approach focuses on a voluntary reduction in menhaden harvest. The approach would establish voluntary quotas that would ensure that catches remain at the targeted level and allow the industry maximum flexibility. Specific agreements/contracts would be developed with each company specifying the agreed-on quota, timing, and other considerations.

6.4.5.3.1 Physical Resources

No adverse impacts on physical resources are expected from this approach. Placing a cap on the fishery and decreasing the fishing effort would decrease deployment of purse seines and provide a short-term benefit to geology and substrates. There would be minor, short-term benefits to air quality by implementing the caps because fishing hours would be reduced. There would be minor, short-term beneficial impacts to noise, since fewer boats on the water in nearshore areas would result in less noise generated by the fishing vessels due to reduced fishing time.

6.4.5.3.2 Biological Resources

As a result of reduced menhaden catch, there would be benefits to other species, including commercially and recreationally important finfish species, marine mammals, and bird species that depend on menhaden as a food source (Akin & Winemiller 2006; Barry et al. 2008; Browder et al. 1983; Fertl & Wursig 1995; Goodyear 1967; King 1989a, 1989b; Leatherwood 1975; Matlock & Garcia 1983). In response to decreases in the Gulf menhaden fishery catch, demand for reduction products (i.e., fish meal, fish oil, and fish solubles) must be met by other fisheries or by other substitute-product markets. The increased demand for these alternative sources of reduction products may result in minor to moderate adverse impacts on biological resources through increased harvest of these replacement sources. Increased bycatch (e.g., marine mammals) may also occur in areas outside the United States.

6.4.5.3.3 Socioeconomic Resources

Localized short- and long-term, moderate adverse impacts to affected local economies (i.e., reduction of spending in fishing communities) may occur as a result of capping the menhaden harvest. (Kirkley 2011) found that a theoretical closure of the Reedville menhaden processing facility on the Chesapeake Bay (where OMEGA Protein is the sole harvester and processor of menhaden into meal and oil) would have a negligible effect on the Virginia economy as a whole, but would substantially affect the surrounding county. If the incentives are not passed on to the labor pool, this project may disproportionately affect temporary labor, which may constitute up to 50 percent of the menhaden processing facility employment base at the height of the season (NMFS 2015). Consequently, menhaden processing companies would be compensated for their participation in the reduced catch program based on a valuation of the projected decrease in menhaden landings resulting from project participation. Socioeconomic impacts on the labor force and fishing communities would also need to be analyzed prior to implementation.

Because menhaden are important prey for many commercially and recreationally important finfish species, this restoration approach may result in long-term, beneficial indirect impacts to recreational and commercial fishing activities. For example, sportfish in the Gulf of Mexico are known to heavily rely on Gulf menhaden for prey (Geers 2012). Reliance of commercial fisheries on menhaden was described earlier, under Biological Resources (Section 6.4.5.3.2). As a result, reducing the amount of menhaden harvested from coastal waters may indirectly benefit commercial and recreational fishers in Gulf waters via enhance catch rates of targeted species.

No construction activities are anticipated for this restoration approach that would adversely affect cultural or historic resources.

6.4.5.4 Incentivize Gulf of Mexico Commercial Shrimp Fishers to Increase Gear Selectivity and Environmental Stewardship

This restoration approach focuses on the inshore and offshore shrimp fisheries operating in the northern Gulf of Mexico to reduce the capture and mortality of bycatch associated with this fishery. There is a variety of restoration techniques that can be used individually, or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Promote gear conversion to more efficient bycatch reduction devices (BRD).

- Promote gear conversion to a hopper post-catch sorting systems.

6.4.5.4.1 Physical Resources

Normal fishing practices for shrimp trawl involve deploying and hauling of gear. The BRD gear modifications are not intended to change fishing behavior in terms of fishing effort or trawl gear type utilized and are therefore not anticipated to result in changes in number of vessels in the Gulf of Mexico. Therefore, impacts to air and/or water quality are not generally anticipated. However, short-term, minor adverse effects to air quality or water quality would occur if implementing the projects requires a trial or gear demonstration for participating vessels that involves the additional use of vessels.

6.4.5.4.2 Biological Resources

Because this approach primarily involves replacing gear and using a catch sorting system, no adverse impacts to biological resources are anticipated. Long-term benefits to biological resources, including commercially important finfish such as red snapper, sea turtles, marine mammals, and birds are expected due to the reduction of bycatch. Discarded bycatch in the commercial shrimp fishery is a waste of natural resources, including finfish species that are integral to Gulf food webs (Crowder & Murawski 1998). Therefore, efforts to reduce bycatch can be expected to have long-term benefits to finfish because finfish make up more than 57 percent of the total penaeid shrimp fishery catch in the Gulf of Mexico and South Atlantic (Scott-Denton et al. 2012). For example, bycatch in the shrimp fishery is a significant source of fishery-induced mortality for the commercially important red snapper, as well as several state and federally managed finfish species in the southeastern United States (Scott-Denton et al. 2012).

6.4.5.4.3 Socioeconomic Resources

This approach is likely to result in some adverse economic impacts to fishers who voluntarily participate in this type of restoration project. In particular, alternative gear may be less efficient than traditional gear, resulting in lower catch rates and additional labor and fuel requirements to catch a similar volume to that caught prior to gear replacement. These adverse impacts are expected to be short-term and long-term and may vary from minor to moderate depending on the affected fishers. However, the financial incentives offered to them could offset these impacts.

Reducing bycatch mortality may result in increases in fish biomass that may, in turn, result in increased catch or fishing opportunities. This can result in long-term economic benefits to commercial and recreational fishers. The scale of these impacts will depend on the specific techniques implemented.

No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.5.5 Enhance Development of Bycatch-Reducing Technologies

In addition to the restoration approaches described above, new technologies could develop during restoration implementation. This restoration approach focuses on the opportunity to use new gear, technology, or fishery information to implement other bycatch reduction efforts as they become known. Knowing that bycatch remains a large concern in Atlantic (including Gulf) fisheries, the Trustees have created this restoration approach to support programs that develop or assist in the development of technological solutions that reduce bycatch of fish species injured during the *Deepwater Horizon* oil spill.

This approach includes the need to understand changes in fishing practices that minimize bycatch of fish, as well as reduce bycatch injury and mortality (including post-release injury and mortality). Funds provided for technological innovation will help accelerate the pace of development of technologies that can ameliorate fishing impacts and create efficiencies for the fishing industry. For technologies that have already shown promise at a pilot scale, this approach can help provide necessary resources to scale up the technology to increase benefits to fish species injured during the *Deepwater Horizon* oil spill. This approach could include workshops to establish goals and objectives for bycatch reduction technological improvements and technological transfer as it relates to injured resources. Funding mechanisms to support bycatch reducing technology and the transfer of these technologies on a large scale to the fishery could also be established.

6.4.5.5.1 Physical Resources

There are no adverse or beneficial impacts on physical resources anticipate as a result of this approach.

6.4.5.5.2 Biological Resources

There are no adverse biological impacts for this approach anticipated. Long-term benefits of funding additional research should be a reduction in fisheries bycatch, potentially across a variety of fisheries.

6.4.5.5.3 Socioeconomic Resources

Minor, short-term adverse effects on the socioeconomic environment may occur. Any potential bycatch solutions that are effective at reducing bycatch may also reduce efficiency in fishery operations and catch. These potential short-term adverse impacts may be resolved in the longer term by other potential implementation solutions identified as part of this approach (e.g., incentives or buy-outs). Funding for bycatch reduction technologies is anticipated to provide economic benefits to recipients of project funds. Reducing bycatch mortality may result in minor increases in fish biomass that may, in turn, result in increased catch or fishing opportunities. This can result in long-term economic benefits to commercial and recreational fishers. The scale of these impacts will depend on the specific techniques implemented.

6.4.5.6 Reduce Post-Release Mortality of Red Snapper and Other Reef Fishes in the Gulf of Mexico Recreational Fishery Using Fish Descender Devices

This restoration approach would reduce the post-release mortality of recreationally caught red snapper *(Lutjanus campechanus)* and other reef fish, such as gag *(Mycteroperca microlepis)*, red grouper *(Epinephelus morio),* and vermilion snapper *(Rhomboplites aurorubens),* in the Gulf of Mexico by promoting the use of fish descender devices (e.g., weighted release devices) among recreational private boat, charter boat, and headboat anglers and providing education so that fishers can effectively use these devices and reduce angler handling time. The recreational reef fish fishery in the Gulf supports an economically important recreational fishery, which, in 2011, consisted of over 3 million recreational anglers taking 23 million trips (NOAA 2012). Among the most important targets in the recreational fishery are reef fish (e.g., snappers, groupers, tilefish, jacks, triggerfishes, and wrasses). Recreational vessels of all sizes target reef fish; these vessels range in size from small, 12-foot private boats to 85 foot headboats that may carry up to 100 individuals (Moran 1988; Sauls et al. 2014).

6.4.5.6.1 Physical Resources

No impacts to the physical environment from use of fish descender devices and improved post-release handling techniques are expected because no equipment that would disturb sediments or geological resources is permanently deployed.

6.4.5.6.2 Biological Resources

Minor and short-term adverse impacts to biological resources are expected as a result of the use of weighted-release devices that create the potential for greater interaction of gear with benthic habitats such as coral and sponge species, although proper training can reduce this potential. The use of weighted-release devices and other techniques to reduce post-release mortality would provide short- and long-term benefits by reducing post release mortality of reef fish. Long-term benefits to reef fish are anticipated because of the increased survival and reproductive success of individual fishes.

6.4.5.6.3 Socioeconomic Resources

This approach would provide funding for the recreational fishing sector to implement practices that result in reduced post-release mortality of reef fish captured by anglers. Depending on recreational anglers' perceptions, this practice could have a minor adverse or positive impact on their fishing experience. For example, if anglers consider using the fish descender devices as an inconvenience or detriment to their fishing experience and/or success, there may be adverse impacts on recreational fishing activities. However, recreational anglers may derive some satisfaction (benefits) associated with releasing fish with fewer impacts from barotrauma.

Reducing bycatch mortality can lead to a minor increase in fish biomass that could in turn result in an increased catch or fishing opportunities. This can result in long-term economic benefit to commercial and recreational fishers. The scale of these impacts will depend on the specific techniques implemented.

No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.5.7 Reduce Gulf of Mexico Commercial Red Snapper and Other Reef Fish Discards Through IFQ Allocation Subsidy Program

This restoration approach focuses on subsidizing fishers in the Gulf of Mexico to use*)* individual fishing quota (IFQ) allocations rather than discard catch in the Gulf reef fish fishery. For instance, some fishers in the eastern Gulf discard a high percentage of red snapper catch. Discarded red snapper have a high rate of post-release mortality. The high discard rate is likely due to insufficient quotas which reduce the profitability of landing red snapper that are caught. The Trustees would establish a mechanism to subsidize the transfer of quota allocations to qualified fishers to reduce the number of discarded reef fish and promote healthy fishing practices. The total amount of quota transferred to participants would be based on Trustee-determined objectives for restoration and implemented in coordination with fishery managers. Successful implementation of this project would reduce the amount of reef fish, including red snapper, discards and associated mortality in the Gulf reef fish fishery.

6.4.5.7.1 Physical Resources

Although it is not likely to increase vessel traffic, this approach could result in a shift in the distribution of the fishery effort to from the western to the eastern Gulf of Mexico, which would result in increased

vessel traffic in localized areas. Increased vessel traffic would be associated with short- and long-term, minor adverse impacts on water quality, air, and noise levels. No other adverse impacts on the physical environment associated with this approach are anticipated. Areas with less vessel traffic would experience long-term benefits associated with improved water quality, air quality, and noise levels.

6.4.5.7.2 Biological Resources

Shifts in fishing activities could result in localized, short- and long-term, minor adverse impacts to biological resources in localized areas, including some additional bycatch of other species during fishing operations in areas where quotas are increased. The restoration approach aims to further bolster the recovering red snapper and other reef fish populations by reducing the mortality of discarded fish resulting from commercial practices. This is expected to achieve long-term beneficial impacts to the red snapper population.

6.4.5.7.3 Socioeconomic Resources

Shifting the distribution of catch would result in distributional economic impacts, adversely affecting some regions while benefiting others. Specifically, there may be region-specific adverse impacts to fishers in the Gulf of Mexico where quotas may be redistributed. The duration and magnitude of these impacts will depend on the specific changes to fishing operations and how fishers adapt to the changes (e.g., shifts to other species of fish or reemployment in other industries). If successful, this approach will benefit commercial fishers and seafood markets in the some areas of the Gulf of Mexico. Regional economic benefits may occur as a result of increased commercial fishing activity in the some areas of the Gulf of Mexico, which could increase spending and employment in these areas. With additional purchasers of allocation or quota, prices could potentially be driven up, so an economic analysis would be undertaken prior to implementation to evaluate the potential for unintended economic consequences.

No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.6 Restoration Type: Sturgeon

The following restoration approaches are proposed for Gulf sturgeon:

- Restore sturgeon spawning habitat.
- Reduce nutrient loads to coastal watersheds (see Section 6.4.3.1 under the restoration type Nutrient Reduction [Nonpoint Source]).
- Protect and conserve marine, coastal, estuarine, and riparian habitats (See Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats).

The restoration approach is restore the spawning habitat and access to the spawning habitat for the federally protected Gulf sturgeon is described below.

6.4.6.1 Restore Sturgeon Spawning Habitat

Gulf sturgeon migrate from marine waters to spawn (lay and fertilize their eggs) in fresh water in the large river systems of the Gulf. Gulf sturgeon typically spawn near limestone outcroppings, cobble, gravel, or other hard bottom habitats (Scollan & Parauka 2008), which are relatively uncommon features in southern U.S. rivers. Gulf sturgeon make long migrations year after year to the same location to take advantage of this spawning habitat. Improving the conditions in these rivers will increase the Gulf sturgeon's ability to spawn and reproduce. A variety of restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Erosion and sediment control or abatement.
- In-stream barrier removal or construction of fish passages.

6.4.6.1.1 Physical Resources

Barrier removal could have short-term and long-term, minor to major impacts to soils, hydrology, air quality, and noise level. Removing a barrier would restore historical stream flows from the upstream water body or reservoir caused by the barrier or dam, flushing sediments and nutrients downstream and potentially temporarily exceeding downstream water quality thresholds for various pollutants. This situation may result in long-term, minor to moderate adverse effects depending on post-removal hydrology, sediment quantity and characteristics, and contaminant characteristics. Depending on the barrier and the method of removal, temporary downstream flooding may be a short-term adverse effect.

Long-term effects of dam and sill removal are numerous and complex and would require site-specific evaluation and appropriate permitting. Short- and long-term, minor to major adverse effects on physical resources are anticipated as a result of barrier removal and stream restoration. For example, conversion of former ponds or reservoirs to riverine habitat could result in declines in local groundwater levels, alter wetland soils, expose former springs, and result in river channel changes.

Barrier removal can also benefit water quality, increasing dissolved oxygen levels, altering water temperature, acidity, nutrient levels, and other metrics (Heinz Center 2002). However, the reconnection of river reaches restores their physical integrity so that the river can operate as an integrated system. This reconnection of river stretches is among the most important long-term benefits of dam removal (Heinz Center 2002).

Additional benefits of barrier removal include the restoration of available sediment and freshwater flows to estuaries and habitat connectivity. Barrier removal would also eliminate the scouring and sediment loss that occurs on the downstream side of a barrier and eliminate the pond or reservoir conditions on the upstream side of the dam.

Erosion and sediment control or abatement activities in Gulf sturgeon spawning habitats would have long-term benefits through reductions in pesticides, metals, and other contaminants that have been identified as possible contributors to Gulf sturgeon decline and/or slow recovery (FWS & GSMFC 1995). Reducing erosion, sedimentation, and, potentially, contaminant loading from adjacent land use practices would improve water quality. The restoration activities could also increase the capacity of a stream and

its banks to accommodate high-flow events, which would decrease erosion further and stabilize geology and substrates over the life of the project.

6.4.6.1.2 Biological Resources

Effects of barrier removal include short- and long-term effects on biological resources. Barrier removal may result in short-term minor to moderate adverse impacts to downstream aquatic resources from increased turbidity during and shortly after removal of the barrier due to the release of impounded sediment. Long-term adverse effects of this sediment release on fish, wildlife, and benthic invertebrates would depend on the extent (if any) of contaminants in the released sediment and this sediment's subsequent fate and transportation in the river.

Barrier removal may also result in short- and long-term, moderate adverse effects to water levels in local wetlands as a result of declines in surface water levels and associated local groundwater levels. Large barrier removal (e.g., dams) may result in a direct loss of species dependent on the open or slow water upstream of the barrier. Reservoirs themselves can also contribute to the creation of wetland areas; draining the reservoir by removing a dam may result in loss of upstream wetlands and/or gain of downstream wetlands (Heinz Center 2002).

Long-term adverse impacts of barriers such as dams that have open water pools or reservoirs upstream that are removed may also include increased opportunities for invasive and non-native species to expand into newly connected areas, requiring invasive species management. Soils in formerly impounded areas would be exposed and eroded and would require management to reduce stormwater runoff, including sediment and contaminants. The exposed area would likely require planting. Downstream of the barrier, erosion could result in the loss of riverine vegetation and subsequent need for additional invasive species management and native species plantings. In addition, removal or bypass of in-stream barriers would enable other aquatic resources to move throughout the river system as well. Long-term benefits to sturgeon are anticipated as a result of restored passage to upstream (spawning) areas. Longer-term effects, including changes in channel morphology and erosion, followed by eventual equilibrium establishment, new floodplains, and native vegetation, can take years or decades to develop (Hart et al. 2002). Gulf sturgeon spawning habitat restoration, protection, and access are anticipated to result in numerous long-term benefits to Gulf sturgeon, including restored access between coastal waters and spawning grounds and subsequent increases in spawning and population size. Barrier removal and restored river flows could scour the river channel upstream of the former barrier and expose hard, limestone and/or gravel bottoms or ledges, restoring spawning habitat for the sturgeon. Overall, the former river floodplain would be restored, resulting in a greater diversity of plants and animals when compared with the barrier and associated upstream water body. Gulf sturgeon spawning habitat restoration, protection, and access would also benefit other wetland and aquatic resources.

Some erosion and sediment control measures may involve shorter-term adverse impacts to local biota, particularly during project construction. However, overall erosion and sediment control or abatement in identified spawning areas is expected to provide long-term benefits to multiple biological resources through improved water quality. In-water construction activities in saltwater areas may cause short-term, minor adverse impacts to marine mammals, such as manatees, if entrapment occurs.

Targeted acquisition of land, gravel rights, or management easements would benefit Gulf sturgeon by protecting areas, including spawning areas, from future disturbances or degradation. In addition, benefits would result from improving water quality by reducing direct runoff and sedimentation, as well as implementing strategies such as barrier bypasses on the acquired land. Depending on the location, land acquisition and management can also increase the amount of habitat for many other species, such as fish and birds.

6.4.6.1.3 Socioeconomic Resources

Depending on the size and type of fish barrier removed or fish passage created, this approach may result in a variety of short-term and long-term socioeconomic effects, both positive and negative, ranging from minor to major.

Barrier removal may result in minor to major adverse impacts to the water supply for agriculture or municipal uses or transportation, flood protection, and hydropower supply, depending on the size and designated use of the barrier that is removed. If reservoir areas behind barriers are eliminated due to barrier removal, flatwater-focused recreational activities could be adversely affected. In addition, barrier removal could affect the aesthetics of upstream and downstream locations, and property values in the vicinity could be affected. Specific impacts of barrier removal on affected industries will be evaluated on a site-specific basis.

Preserving habitat by acquiring property or through conservation easements would permanently limit the amount and type of development permitted, and the management and the intensity of use on these properties would likely change. Land conservation or acquisition may result in restrictions on public access in areas where public access had previously been allowed, which could reduce recreational opportunities. Projects that result in changes in ownership and/or permitted uses could affect property taxes. Land acquisition could have a minor to moderate impact on socioeconomic resources due to changes in visitor spending and tax impacts. The transfer of fee title to lands and the creation of conservation easements, however, are transactions negotiated or arranged between willing parties and, as such, are not expected to give rise to adverse socioeconomic impacts to those who choose to engage in such transactions.

Barrier removal as well as erosion and sediment control or abatement measures may result in short-term benefits to the local economy through an increase in employment and associated spending in the project area during construction activities, and removal of dams can have both economic and safety benefits. For example, many dams in the United States are aging (Heinz Center 2002), which results in deterioration of construction materials, and dams are more prone to failure, resulting in both economic and safety concerns (Poff & Hart 2002). Maintaining these structures can be as much as three times greater than the cost of removing them (Poff & Hart 2002).

Recreational activities, particularly wildlife-related recreation, may benefit from removal of fish barriers or improved fish passages. Barrier removal could also improve recreational navigation along a waterway, increasing the ability of boats to move from one area to an adjacent area.

Cultural resource impacts would be site-specific and would depend on what resources were protected or enhanced. Indirect beneficial impacts to cultural resources could result if conservation includes

protecting historic and cultural resources that are within or close to protected areas. If cultural or historic resources are present, minor to moderate adverse impacts to the resource would be anticipated during construction activities such as dredging and placement/removal of sediments or other materials used during restoration activities. Adverse impacts could include physical destruction or alteration of all or part of a cultural or historic resource and may directly alter, damage, or destroy resources such as historic shipwrecks, engineering structures or landscapes, or connectivity with related sites. Discovery or recovery of cultural or historic resources would allow the future protection of the resource.

6.4.7 Restoration Type: Sea Turtles

The following restoration approaches are proposed under the restoration type for sea turtles:

- Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures.
- Reduce sea turtle bycatch in commercial fisheries through enhanced training and outreach to the fishing community.
- Enhance sea turtle hatchling productivity and restore and conserve nesting beach habitat.
- Reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures.
- Reduce sea turtle bycatch in commercial fisheries through enhanced state enforcement effort to improve compliance with existing requirements.
- Increase sea turtle survival through enhanced mortality investigation and early detection of and response to anthropogenic threats and emergency events.
- Reduce injury and mortality of sea turtle from vessel strikes.
- Reduce mortality among Highly Migratory Species and other oceanic fishes (See Section 6.4.5.2 under the restoration type Fish and Water Column Invertebrates).

6.4.7.1 Reduce Sea Turtle Bycatch in Commercial Fisheries Through Identification and Implementation of Conservation Measures

This restoration approach focuses on reducing the bycatch and mortality of sea turtles in Gulf of Mexico commercial fisheries by identifying, developing, and implementing sea turtle bycatch reduction measures. Sea turtles are known to interact with several gear types, including bottom longline, pelagic longline, trawls, gillnets, and pots/traps (NMFS & FWS 2008; NMFS et al. 2011). This restoration approach would identify potential bycatch reduction measures such as gear modifications, changes in fishing practices, and/or temporal and spatial fishery management in Gulf commercial fisheries. Restoration techniques for this approach include, but are not limited to, the following:

- Pre-implementation studies to develop and test bycatch reduction measures.

- Implementation of bycatch reduction measures (e.g., use of large circle hooks and reduced soak time when fishing for reef fish).

6.4.7.1.1 Physical Resources

Normal fishing practices for shrimp trawl, menhaden purse seine, and trap/pot fisheries involve deploying and hauling of gear. These routine practices may cause temporary, minor disruption of the benthic habitat and water column, but are not expected to increase as a result of this restoration approach.

6.4.7.1.2 Biological Resources

The proposed changes in gear and fishing practices to reduce bycatch are not expected to adversely affect other species or habitats, therefore no adverse impacts to biological resources are expected. Bycatch reduction solutions that are developed and implemented are expected to directly reduce sea turtle bycatch in fishing gear and may also reduce bycatch of marine mammal and fish species. Improved bycatch reduction techniques could have long-term beneficial effects on sea turtle populations by reducing the number of sea turtles incidentally caught as bycatch as a result of current fishing practices.

6.4.7.1.3 Socioeconomic Resources

Minor, short-term adverse effects on the socioeconomic environment may occur. Any potential bycatch solutions that are effective at reducing bycatch may also reduce efficiency in fishery operations and catch. These potential short-term adverse impacts may be resolved in the longer term by other potential implementation solutions identified as part of this approach (e.g., incentives or buy-outs). Any ground-disturbing restoration activities would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

Funding for bycatch reduction technologies is anticipated to provide economic benefits to recipients of project funds. Reducing bycatch mortality may result in minor increases in fish biomass that may, in turn, result in increased catch or fishing opportunities. This can result in long-term economic benefits to commercial and recreational fishers. The scale of these impacts will depend on the specific techniques implemented.

6.4.7.2 Reduce Sea Turtle Bycatch in Commercial Fisheries Through Enhanced Training and Outreach to the Fishing Community

This restoration approach involves an increase in training and outreach to the fishing community to improve compliance with bycatch reduction requirements to reduce the bycatch of sea turtles in fisheries. The approach could expand the NOAA Gear Monitoring Team (GMT) model program to provide a greater capacity for education, outreach, and training to the principle fishing sectors that interact with sea turtles (i.e., shrimp trawl [otter and skimmer], pelagic and bottom longline, gillnet, and hook-and-line).

This restoration approach could expand the successful NOAA Gear Monitoring Team (GMT) program, which operates in the Gulf states out of the NMFS Southeast Fisheries Science Center's Pascagoula Lab, to the Gulf states. This expansion would allow similar programs to be implemented at the state-level. The approach could also add a new NOAA GMT in the southeastern U.S. Atlantic. Broadening of the existing, successful program and integrating federal and state efforts into an effective partnership would

maximize the likelihood of success. The primary goal of an expanded GMT program is to provide a greater capacity for outreach, education, and training to the principle fishing sectors that interact with sea turtles (i.e., shrimp trawl [otter and skimmer], PLL, bottom longline, gillnet, and hook-and-line fisheries).

6.4.7.2.1 Physical Resources

Enhanced training and outreach to reduce sea turtle bycatch is not expected to have adverse or beneficial effects on physical resources because actions include on-water and/or at dock courtesy inspections, as part of the GMT program, and would not increase the fishing effort.

6.4.7.2.2 Biological Resources

Increased training and education is intended to increase compliance with existing sea turtle bycatch reduction requirements for fisheries. Increased compliance with these requirements would provide benefits to sea turtles by reducing sea turtle bycatch and mortality.

6.4.7.2.3 Socioeconomic Resources

Adverse socioeconomic impacts are not expected from this restoration approach. However, any ground-disturbing restoration activities would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. Increased education and outreach can directly benefit individuals, groups, and businesses involved in commercial fishing in the region. Education and outreach should allow fishers to be in better compliance with regulations and potentially avoid citations associated with noncompliance.

6.4.7.3 Enhance Sea Turtle Hatchling Productivity and Restore and Conserve Nesting Beach Habitat

This restoration approach focuses on restoring and conserving nesting beach habitat for sea turtles. In Florida and Alabama, the restoration would benefit nesting loggerheads and green turtles, while in Texas, Kemp's ridleys would benefit. While on land, these turtles face a variety of threats. This restoration approach involves ameliorating some of these threats and as such represents an opportunity to improve turtle reproductive success. There are a variety of restoration techniques that can be used individually, or in combination, as potential restoration projects. Not all restoration techniques are suitable for all locations. This restoration approach could employ, but is not limited to, the following techniques:

- Reduce beachfront lighting on nesting beaches.
- Enhance protection of nests.
- Acquire lands for conservation of nesting beach habitat.
- Promote beach user outreach and education.

6.4.7.3.1 Physical Resources

Predator control may involve the use of vehicles on nesting beaches to locate predators or set/check traps; however, these effects are expected to be short-term and will be designed to minimize disturbance to nesting sea turtles and their nests. Screening or caging of nests and nest relocation (if necessary) could have a short-term, minor adverse impact to affected substrates, but disturbed sites would be restored after placement of screens/cages or removal of turtle eggs. Minor, short-term

adverse impacts to ambient noise levels could occur during implementation of lighting projects (e.g., removing pole mounted lights and installing new, turtle-friendly lighting), which could result in temporary changes to ambient noise conditions, air quality impacts from increased monitoring via vehicles, and/or long-term compaction due to increased vehicle use. These changes would be only slightly apparent to visitors while this technique is being implemented and would not attract attention, dominate the soundscape, or detract from current user activities or experiences.

Restoration efforts to protect and conserve sea turtle nesting beaches, whether through site-specific projects, fee acquisition, or conservation easements, could provide numerous long-term benefits to beach habitats. Preservation could allow beach and dune migration and sediment migration, which would have long-term beneficial effects on geology and substrates over the life of the project. Conservation could also allow for upland migration as sea level rises and could limit development encroachment. Shoreline habitats landward of the beach (e.g., wetlands) could benefit from adjacent beach and dune area protection because these areas provide protection from storm surge and reduce erosion.

6.4.7.3.2 Biological Resources

Adverse effects to sea turtles or other species (i.e., birds) could result from restoration activities requiring human activity and vehicle traffic on nesting beaches. Nest relocation, if necessary, could result in short- to long-term adverse effects, embryo death due to handling, decreased hatching and emergence success, and increased predation of concentrated nests. Adverse effects from implementation of exclusion caging or predator control could occur to species that use the affected area. If used for management of egg predators, poison baits could enter the waterway through air application and leach into adjacent surface or ground waters, but these effects would be minimized through proper use. Predator control efforts also have the potential to result in indirect adverse ecological effects (e.g., encouraging nontargeted, potentially undesirable predators to become established).

Protection and conservation of sea turtle nesting beaches would minimize development encroachment on nesting and foraging habitat, which would be a long-term benefit to birds, sea turtles, terrestrial wildlife, and other species that use the beach habitat. For rare wildlife species (such as beach mice) that depend on beach or dune habitat, protection and conservation of habitat could have a long-term benefit.

Beach habitats contribute to the quantity and quality of adjacent shallow water habitats that serve as nurseries or forage areas for some finfish species. The beach-shallow water interface also provides nutrient exchange to aquatic habitats. Protecting these habitats could result in a long-term benefit to these species and indirectly benefit the food chain that relies on the health of adjacent shallow water areas.

Nesting beach improvement via predator control and use of turtle-friendly lighting, as well as nest detection, monitoring, and protection (such as nest screening or caging), could provide a long-term benefit to sea turtles by increasing nesting success and hatchling survivorship, resulting in a higher number of sea turtles surviving to adulthood and reproductive life stages. For example, turtle-friendly lighting would reduce artificial light sources to minimize the potential for both nesting females and

hatchlings to become disoriented or misoriented. Predator control on the beaches could also benefit nesting birds and other wildlife by reducing nest predation, while increased hatchling survivorship would improve food sources for herons and ghost crabs that prey on hatchlings before they enter the water and species that prey on post-hatchlings in the water.

6.4.7.3.3 Socioeconomic Resources

Preserving habitat by acquiring property through fee acquisition or protecting property through conservation easements would permanently limit the amount and type of development that would be permitted on these lands, and the management and the intensity of use on these properties would likely change. Land conservation or acquisition may result in restrictions on public access in areas where public access had previously been allowed, which could reduce recreational opportunities. Projects that result in changes in ownership and/or permitted uses could affect property taxes and have broader regional economic impacts resulting from changes in visitor spending in the region. Land acquisition could have a minor to moderate adverse impact on socioeconomic resources due to changes in visitor spending and tax impacts. The transfer of fee title to lands and the creation of conservation easements, however, are transactions negotiated or arranged between willing parties and, as such, are not expected to give rise to adverse socioeconomic impacts to those who choose to engage in such transactions.

Implementation of this approach at national, state, and local parks; wildlife refuges; and wildlife management areas, could result in short-term, minor adverse impacts to land and marine management. These impacts would be temporary and would occur primarily if activities result in partial or full closure of these areas. If closures did occur, impacts could include public access restrictions to parts of the park, interruption of certain interpretive programs, and similar impacts. In the long term, these techniques would have beneficial impacts on land and marine management at parks, wildlife refuges, and wildlife management areas because these restoration activities would help park management and staff members fulfill their obligations to manage these properties for the benefit of the environment and the public. Any ground-disturbing restoration activities would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

Beneficial impacts to recreational experiences and wildlife viewing from this restoration approach could also occur as a result of the improvement of wildlife and aquatic species habitat. This approach could produce short-term benefits to regional economies. The distribution of economic benefits within the region would also depend on the locations or sourcing of labor, supplies, materials, and equipment. These regional economic benefits would include jobs, income, sales, and tax receipts.

6.4.7.4 Reduce Sea Turtle Bycatch in Recreational Fisheries Through Development and Implementation of Conservation Measures

This restoration approach focuses on reducing and minimizing the bycatch of sea turtles in recreational fisheries in the nearshore, shallow water habitats of the Gulf of Mexico. Restoration techniques for this approach include, but are not limited to, the following:

- A comprehensive inventory and characterization of recreational fisheries, initially focused on piers and similar fixed structures in the Gulf of Mexico where bycatch of sea turtles has been reported or is likely to occur.

- The identification of factors that may contribute to sea turtle bycatch (e.g., bait type and hook type) and studies to test bycatch reduction measures.
- Implementation of conservation measures as appropriate.

6.4.7.4.1 Physical Resources

Because it primarily involves characterizing and testing new techniques to reduce turtle bycatch in open water areas or test facilities, no adverse or beneficial effects to physical resource are expected from this restoration approach.

6.4.7.4.2 Biological Resources

Short-term, minor adverse effects to sea turtle and/or fish populations could be caused by testing new bycatch reduction techniques. Long-term beneficial effects to sea turtle populations could be observed with a reduction in sea turtle bycatch in recreational fisheries.

Reductions in bycatch of sea turtles and injury/mortality of sea turtles caught in recreational fisheries would have benefits for adult and juvenile sea turtles. Adult and juvenile sea turtles have survived the high mortality rates at younger, smaller life stages and are extremely valuable to the population, as they are either already reproductively active or have a high likelihood of surviving to reproduce. Additional benefits could include increased knowledge regarding the capture of other nontarget species. The biological benefits of cleaning up recreational fishing debris around piers and other known fishing locations would be fewer organisms entangled in or ingesting marine debris.

6.4.7.4.3 Socioeconomic Resources

Socioeconomic impacts will depend on the restoration project implemented to reduce sea turtle bycatch in recreational fisheries. Long-term, minor adverse impacts could occur if conservation measures implemented disrupt recreational fishing opportunities. Studies to inventory recreational fisheries, or investigate factors contributing to turtle bycatch, could result in long-term beneficial effects due to a slight increase in regional employment if local labor is employed.

6.4.7.5 Reduce Sea Turtle Bycatch in Commercial Fisheries Through Enhanced State Enforcement Effort to Improve Compliance with Existing Requirements

This restoration approach would enhance state enforcement of sea turtle bycatch reduction requirements for fisheries conducted in state waters through increased training and outreach of relevant state enforcement personnel and increased state fisheries enforcement effort.

6.4.7.5.1 Physical Resources

Potential long-term, minor adverse effects of this approach could include temporary, localized disturbance and suspension of sediments from increased enforcement vessel traffic on the water; temporary, localized impacts on air quality and noise could also occur. Long-term beneficial effects may occur from implementation of innovative solutions (e.g., gear modifications, best fishing practices, and safe deterrence methods) and outreach to fishers, which may prevent fishing gear from becoming derelict and disturbing bottom sediments.

6.4.7.5.2 Biological Resources

Potential long-term, minor adverse effects of this approach could include temporary, localized disturbance to marine mammals, sea turtles, and birds in nearshore waters from increased enforcement vessel traffic. Possible direct biological consequences would be short-term and minor. The increased vessel traffic from additional enforcement activities could potentially result in increased disturbance of sea turtles, marine mammals, and other marine organisms. The possibility of vessel strikes of sea turtles and marine mammals from increased enforcement vessel activity also exists, but is likely extremely low.

Increased training and education is intended to increase compliance with existing sea turtle bycatch reduction requirements for fisheries conducted in state waters. Increased compliance with these requirements would provide benefits to sea turtles by reducing sea turtle bycatch and mortality.

6.4.7.5.3 Socioeconomic Resources

Adverse socioeconomic consequences are not expected. Instances of noncompliance are also expected to decrease over time if steady, consistent enforcement efforts are applied. Beneficial effects include the potential for law enforcement job opportunities and reduced conflict among legal and illegal fishers.

6.4.7.6 Increase Sea Turtle Survival Through Enhanced Mortality Investigation and Early Detection of and Response to Anthropogenic Threats and Emergency Events

This restoration approach involves enhancing the infrastructure and capacity of the Gulf of Mexico Sea Turtle Stranding and Salvage Network (STSSN). This restoration approach could provide additional support to the STSSN through 1) enhanced proactive stranding response and/or dedicated surveys, 2) improved ability to respond to stranding events, 3) enhanced investigation of mortality sources, 4) enhanced rehabilitation capability where necessary, and 5) improved coordination and communication among and between rehabilitation facilities, state coordinators, USFWS, and NOAA.

6.4.7.6.1 Physical Resources

Enhancing the STSSN could result in localized long-term, minor adverse impacts to physical resources associated with human activities and use of equipment during mobilization of stranding and response efforts on beaches. A slight increase in the use of vessels and/or vehicles may occur due to implementation of this approach as responses to marine-based stranding events (e.g., cold stun events) or land-based strandings increase.

6.4.7.6.2 Biological Resources

Increased response activities could potentially result in long-term, minor adverse impacts to fish and wildlife due to increased vessels and/or vehicle interactions.

Benefits of an improved STSSN include a likely increase in the success of rescue, rehabilitation, and release of live sea turtles. Mortality investigations, as well as other data collected by enhanced stranding networks, would better guide NOAA and other natural resource managers. This would provide long-term benefits to sea turtles and other species, such as marine mammals, that could be identified during stranding response activities.

6.4.7.6.3 Socioeconomic Resources

An expanded STSSN and development of an emergency response program would increase the ability for personnel to respond to sea turtle stranding events and/or emergencies on water or land. Long-term, minor adverse effects could be created by increasing human and vehicular traffic in responding to strandings, which could negatively affect boater or beachgoer experiences. Beneficial effects could include some job opportunities associated with the STSSN. The expansion of the existing stranding network would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

6.4.7.7 Reduce Injury and Mortality of Sea Turtles from Vessel Strikes

This restoration approach focuses on reducing the injury and mortality of sea turtles from vessel strikes in the Gulf of Mexico. Restoration techniques for this approach include, but are not limited to, public outreach and education, a comprehensive review of the temporal and spatial distribution of vessel strikes, and additional cofactors that may influence the frequency of vessel strikes (e.g., water depth, vessel speed, and vessel size), and the development and implementation of potential mechanisms to reduce the frequency of vessel strikes (e.g., voluntary speed restrictions or vessel exclusion areas in highest risk locations).

6.4.7.7.1 Physical Resources

Because this approach involves activities in offices, laboratories, open water areas, or test facilities, no adverse or beneficial effects to physical resource are expected from this restoration approach.

6.4.7.7.2 Biological Resources

Because this approach involves educational outreach activities that would be conducted in offices, laboratories, open water areas, or test facilities, no adverse impacts are anticipated from this restoration approach. Long-term beneficial effects to sea turtle populations would be observed with a reduction of sea turtle injury and mortality from vessel strikes. Reductions in vessel strikes would have benefits for adult and juvenile Kemp's ridley, loggerhead and green sea turtles. Adult and juvenile sea turtles are extremely valuable to the population, as they are either already reproductively active or have a high likelihood of surviving to reproduce. Additional benefits could include increased knowledge regarding the frequency of vessel strikes and factors contributing to those events.

6.4.7.7.3 Socioeconomic Resources

Socioeconomic impacts will depend on the restoration project implemented to reduce sea turtle injury and mortality from vessel strikes. Long-term, minor adverse impacts could occur if conservation measures implemented disrupt recreational boating or commercial shipping practices through voluntary speed restrictions or vessel exclusion areas.

6.4.8 Restoration Type: Submerged Aquatic Vegetation

One approach is proposed for SAV, which focuses on restoring and supporting healthy SAV communities. This approach is described further below.

6.4.8.1 Restore and Enhance Submerged Aquatic Vegetation

This restoration approach focuses on restoring and protecting SAV habitat. Healthy SAV serves critical ecological functions in the Gulf of Mexico, including serving as habitat and forage for fish and wildlife,

decreasing wave energy, protecting soil, and increasing sediment accretion (Beck et al. 2007; Fonseca 1996; Fonseca & Bell 1998; Heck Jr. et al. 2008; NPS 2014; Orth et al. 2006). Therefore, minimizing further deterioration and erosion of sediment and enhancing vegetation communities can improve stability and colonization in SAV beds. SAV can also provide habitat and foraging areas for invertebrates, sea turtles, fish, water fowl, and wading birds(Fonseca 1996; Fonseca & Bell 1998). Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects (Farrer 2010; Fonseca 1996; Fonseca & Bell 1998; Paling et al. 2009; Thomson et al. 2010; Treat & Lewis III Eds. 2006). This restoration approach could employ, but is not limited to, the following techniques:

- Backfill scars with sediment.
- Revegetate SAV beds via propagation and/or transplanting.
- Enhance SAV beds through nutrient addition.
- Protect SAV beds with buoys, signage, and/or other protective measures.
- Protect and enhance SAV through wave attenuation structures.

6.4.8.1.1 Physical Resources

SAV restoration and enhancement projects that involve construction (i.e., backfill scars with sediment, install buoys/signs, and construct attenuation structures) could have short-term, minor adverse impacts on geology, substrate, and water quality due to sediment disturbance during construction at both the borrow site (for backfill sediments) and the placement site. Depending on the type of wave attenuation structure, there could be a minor, permanent change in substrate type. Possible minor adverse effects could include temporary, localized disturbance and suspension of sediments in nearshore waters and impacts on air and noise quality from increased vessel traffic during construction. Long-term, minor adverse impacts on air quality and noise could be expected through emissions and noise associated with increased recreational use of the restored SAV habitat.

Long-term beneficial impacts to geology and substrate would result because SAV protection would maintain the stabilization of sediments in the area, reducing possible future erosion and minimizing wave action on nearby shorelines. A long-term beneficial effect on water quality could be realized through the uptake of nutrients and particulates and sediment stabilization by an enhanced or restored SAV community.

6.4.8.1.2 Biological Resources

Disturbance and removal of sediments from dredging of sediment for backfilling scars and placement of wave attenuation structures could result in short-term, minor adverse impacts due to disturbance, displacement, and/or mortality of benthic organisms at both the borrow site and the placement site. A possible adverse long-term impact can result if stakes are left at the site for a prolonged period of time, causing a shift in the species of SAV growing at the site (Powell et al. 1989). Adjacent benthic populations would be expected to move into the borrow site and recolonize quickly, within one to three years (Greene 2002).

Long-term beneficial impacts to biological resources would be expected due to the restoration or enhancement of the SAV community. Restored SAV would promote the growth of healthy algal communities in the area. SAV beds provide important aquatic habitat for fish and invertebrates to use for foraging and spawning. In addition to directly benefitting SAV, all techniques under this restoration

approach benefit shallow water habitat. This would improve the ecological integrity and continuity among resources that use SAV for foraging, shelter, and spawning habitat.

6.4.8.1.3 Socioeconomic Resources

Some protective measures may have negative socioeconomic impacts. For instance, "no-motor zones" could negatively affect local fishing and tourism, while the installation of signs and markers could be informative but may necessarily result in a change to recreational activity. The impact will depend on the specific type of protective measure and the project site.

Beneficial socioeconomic impacts would be expected from implementation of this restoration technique by increasing fishery resources that would in turn benefit commercial and recreational fisheries and other recreational activities (i.e., boating, diving, hunting, and bird watching).

SAV restoration may provide localized short-term socioeconomic benefits during project implementation related to an increase in employment and associated spending in the project area during construction.

Restoration of SAV beds could provide long-term, minor beneficial impact to coastal infrastructure by reducing intensity of storm waves on nearby shorelines and infrastructure.

Impacts on cultural resources resulting from the implementation of this restoration approach are dependent on site-specific conditions associated with a project proposed for implementation. If cultural or historic resources are present, minor to moderate adverse impacts to the resource would be anticipated during construction activities, such as dredging and placement/removal of sediments or other materials used during the restoration, but would depend on site-specific conditions associated with a project proposed for implementation.

6.4.9 Restoration Type: Marine Mammals

The following restoration approaches are proposed under the restoration type for marine mammals:

- Reduce commercial fishery bycatch through collaborative partnerships.
- Reduce injury and mortality of bottlenose dolphins from hook and line fishing gear.
- Increase marine mammal survival through better understanding of causes of illness and death and early detection and intervention of anthropogenic and natural threats.
- Measurement of noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals.
- Reduce injury, harm, and mortality to bottlenose dolphins by reducing illegal feeding and harassment activities.
- Reduce marine mammal takes through enhanced state enforcement related to the Marine Mammal Protection Act.
- Reduce injury and mortality of marine mammals from vessel collisions.

- Protect and conserve marine, coastal, estuarine, and riparian habitats (see Section 6.4.1.5 under the restoration approach Wetlands, Coastal and Nearshore Habitats).

The following sections describe the environmental consequences of these approaches.

6.4.9.1 Reduce Commercial Fishery Bycatch Through Collaborative Partnerships

This restoration approach focuses on reducing direct interactions between bottlenose dolphins with shrimp trawl, menhaden, and trap/pot fishing gear through collaborative partnerships to identify, test, and implement solutions. Techniques to reduce direct interactions between bottlenose dolphins with shrimp trawl, menhaden, and trap/pot fishing gear developed as a tiered approach may include, but are not limited to, the following:

- Develop collaborative partnerships and convene workshops to characterize interactions and determine the best strategies for reducing marine mammal bycatch in commercial fishing gear.
- Implement the solutions identified by these partnerships.
- Monitor and evaluate effectiveness of bycatch reduction actions.

6.4.9.1.1 Physical Resources

Normal fishing practices for shrimp trawl, menhaden purse seine, and trap/pot fisheries involve deploying and hauling of gear. These routine practices may cause temporary, minor disruption of the benthic habitat and water column, but are not expected to increase as a result of this restoration approach. Thus, this approach is not anticipated to result in impacts to physical resources. Long-term benefits may occur from implementation of innovative solutions (e.g., gear modifications, best fishing practices, and safe deterrence methods) and outreach to fishers, which may prevent fishing gear from becoming derelict and disturbing bottom sediments.

6.4.9.1.2 Biological Resources

The proposed changes in gear and fishing practices to reduce marine mammal bycatch are not expected to adversely affect other species or habitats, therefore, no adverse impacts to biological resources are expected. Bycatch reduction solutions that are developed and implemented are expected to directly reduce marine mammal bycatch in fishing gear and may also reduce bycatch of sea turtle and fish species. Increased and enhanced monitoring and data collection are expected to help natural resource managers in making more informed decisions in protecting marine mammals, sea turtles, fisheries, and their habitat.

6.4.9.1.3 Socioeconomic Resources

Minor, short-term adverse effects on the socioeconomic environment may occur. Development of successful bycatch reduction techniques may require research to ensure a fisher's catch is not negatively affected. The collaborative partnership and stakeholder-based process of this approach is designed to identify bycatch reduction solutions that reduce dolphin bycatch while still allowing for fishery operations. However, any potential bycatch solutions that are effective at reducing dolphin bycatch may reduce efficiency in fishery operations and catch. These potential short-term adverse impacts may be resolved in the longer term by other potential implementation solutions identified as part of this

approach (e.g., incentives or buy-outs).No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.9.2 Reduce Injury and Mortality of Bottlenose Dolphins from Hook and Line Fishing Gear

This restoration approach focuses on reducing the harmful impacts of hook-and-line fishing on marine mammals. Restoration techniques to reduce injury to bottlenose dolphins from hook and line fishing may include, but are not limited to, the following:

- Enhance understanding of the baseline frequency, scope, scale, and nature of these interactions through systematic surveys of fishers and continued evaluation of stranding data.
- Develop collaborative partnerships and convene workshops with stakeholders to identify and implement effective actions for reducing interactions in hook-and-line gear.
- Systematically repeating surveys and stranding data evaluations to measure success.

6.4.9.2.1 Physical Resources

No adverse effects to the physical environment are expected from these efforts to reduce fishing interactions between anglers and dolphins, since modifications would likely reduce the amount of derelict hook-and-line fishing gear in the water. Long-term beneficial effects are expected from implementation of innovative solutions (e.g., gear modifications, best fishing practices, and safe deterrence methods) and outreach to fishers, which may prevent fishing gear from becoming derelict and disturbing bottom sediments.

6.4.9.2.2 Biological Resources

Long-term benefits to biological resources are expected because the development and implementation of innovative solutions to directly reduce dolphin interactions with hook-and-line gear would result in a reduction in injury and death to bottlenose dolphins. Outreach and education on these solutions is also expected to further raise awareness among fishers on how to prevent interactions with dolphins. This may further prevent dolphins from teaching these unnatural behaviors to other dolphins. Innovative solutions may also benefit sea turtles and other protected species by reducing any potential interactions with the gear.

6.4.9.2.3 Socioeconomic Resources

Minor, short-term adverse effects on socioeconomic resources may occur from this restoration approach. Any short-term adverse impacts from participation are expected to be offset by long-term beneficial impacts from reduced dolphin interactions with fishing gear and resulting damage to gear and catch.

No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.9.3 Increase Marine Mammal Survival Through Better Understanding of Causes of Illness and Death and Early Detection and Intervention of Anthropogenic and Natural Threats

This restoration approach focuses on increasing marine mammal survival through improving understanding of key causes of morbidity and mortality and also on the early detection and mitigation of anthropogenic or natural threats. The outcomes of this approach are anticipated to have positive impacts on the survival of many marine mammal species in the Gulf of Mexico, but in particular on BSE and coastal stocks of bottlenose dolphins. Other offshore species that are subject to mass strandings or die-offs may also benefit, including short-finned pilot whales (*Globicephala macrorhynchus*) and rough-toothed dolphins (*Steno bredanensis*). This restoration approach could employ, but is not limited to, the following techniques:

- Expand the Marine Mammal Stranding Network's (MMSN's) capabilities along the coast of the Gulf of Mexico.
- Enhance capabilities to rapidly diagnose causes of marine mammal morbidity and mortality to identify threats and mitigate impacts (conservation medicine).
- Improve the ability to detect and rescue free-swimming dolphins that are entangled, entrapped (e.g., due to levee construction), or out of habitat (e.g., due to hurricane displacement).
- Develop and increase the technical and infrastructure capabilities to respond to major stranding events or disasters (natural and anthropogenic).

6.4.9.3.1 Physical Resources

There may be short-term, minor adverse effects to geology, substrates, and water quality during stranding responses due to use of temporary pools for rehabilitation of stranded mammals, contamination (e.g., from wastes or pathogens), and carcass burial on site. Rehabilitation facilities would have necessary permits for wastewater discharges.

6.4.9.3.2 Biological Resources

There may be short-term, minor adverse impacts to marine mammals and/or other species incidental to response activities. For example, rescue attempts and associated increases in travel and activity may result in habitat disturbance or accidental injury to another animal during the response. However, improved response would likely increase the success of rescue, rehabilitation, and release of live marine mammals. Marine mammal stranding data, as well as other data collected by enhanced stranding networks, would better guide NMFS and other natural resource managers in managing and protecting marine mammals and their habitat. Therefore, this restoration approach would provide long-term benefits to marine mammal populations.

6.4.9.3.3 Socioeconomic Resources

An expanded MMSN would increase the ability for personnel to respond to marine mammal stranding events and/or emergencies on water or land. A slight increase in the use of vessels and/or vehicles to respond to marine-based stranding events (e.g., entanglements or entrapments) or land-based strandings may result due to implementation of this approach. Long-term, minor adverse effects could be created by increasing human and vehicular traffic during strandings responses, which could

negatively affect boater or beachgoer experiences. Beneficial effects could include some job opportunities associated with the MMSN.

No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.9.4 Measurement of Noise to Improve Knowledge and Reduce Impacts of Anthropogenic Noise on Marine Mammals

This restoration approach focuses on utilizing passive acoustics and other technologies to characterize the spatial overlap between noise and marine mammal stocks to inform noise reduction actions in appropriate areas. This will be accomplished through techniques that include, but are not limited to the following:

- Characterize spatial and temporal distributions and density of marine mammals in the Gulf.
- Characterize ocean noise throughout the Gulf.
- Develop collaborative partnerships to identify and implement noise reduction measures.

6.4.9.4.1 Physical Resources

Short-term and long-term reductions in anthropogenic noise (e.g., noise from commercial ships and recreational watercraft, oil and gas exploration, sonar, marine pile driving, and underwater explosions) may be anticipated as a result of improved technologies that can be used to reduce ambient or acute noise.

6.4.9.4.2 Biological Resources

Short-term, minor adverse impacts could result from the deployment of passive acoustics and other technologies to evaluate and address noise impacts on marine mammals. For example, increased vessel activity for deploying and monitoring effects of noise may result in increases in direct interactions with marine mammals. Long-term benefits to marine mammals would include reduction of anthropogenic ocean noise, which could help marine mammals maintain a viable population.

6.4.9.4.3 Socioeconomic Resources

This approach would potentially result in long-term, minor to moderate indirect adverse impacts on industries where noise is an issue (e.g., shipping, dredging, marine construction, military sonar testing, and energy). Depending on outcomes of the workshop and the strategies and technologies developed to reduce noise impacts on marine mammals, industries may change behaviors, which could result in either costs or benefits to individual operations. Noise reducing strategies can benefit shipping industries, since typical noise reduction technologies focus on creating efficient operation for large ships. Updated, efficient ships could decrease utilization costs for shipping companies. Noise reduction technologies include propeller design, engine design, engine placement within ships, and vibration control.

No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.9.5 Reduce Injury, Harm, and Mortality to Bottlenose Dolphins by Reducing Illegal Feeding and Harassment Activities

This restoration approach focuses on reducing harmful impacts to marine mammals from illegal feeding and harassment activities by people. This restoration approach includes, but is not limited to, the following techniques:

- Conduct human dimension studies (e.g., surveys, focus groups, and interviews).
- Implement outreach and education strategies based on human dimension study outcomes.
- Partner with stakeholders to widely distribute and communicate tools/strategies to effectively reach targeted user groups throughout the Gulf of Mexico.

6.4.9.5.1 Physical Resources

No adverse impacts to physical resources are anticipated as a result of implementation this restoration approach, since it is limited to studies, outreach, and education and includes no disturbance of soils, substrates, or other physical resources.

6.4.9.5.2 Biological Resources

Reducing interactions between humans and wild bottlenose dolphins is expected to reduce associated harm, related mortality, and long-term chronic stress to animals and populations.

6.4.9.5.3 Socioeconomic Resources

Adverse socioeconomic consequences associated with this approach are not expected. Instances of noncompliance are also expected to decrease over time if steady, consistent enforcement efforts are applied. Implementation of this restoration approach is expected to reduce illegal human activities causing harm to bottlenose dolphins. No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.9.6 Reduce Marine Mammal Takes Through Enhanced State Enforcement Related to the Marine Mammal Protection Act

This restoration approach builds capacity and training for state enforcement agencies to implement the MMPA in their state waters. This approach could include working with Gulf states individually to identify training needs and the most appropriate venue and format for the delivery of MMPA-related training. This approach could also include developing and distributing outreach products or techniques targeted specifically to officers. In addition, this approach could provide increased funding to state enforcement agencies to increase the percentage of time that officers and equipment (e.g., vessels) are dedicated to MMPA enforcement activities.

6.4.9.6.1 Physical Resources

Potential long-term, minor adverse effects of this approach could include temporary, localized disturbance and suspension of sediments from increased enforcement vessel traffic on the water; temporary localized impacts on air quality and noise could also occur.

Enhanced enforcement of the MMPA could increase routine boat and all-terrain vehicle operations by state enforcement agencies, which could have long-term, minor adverse impacts to substrate, as well as to air quality, and noise.

6.4.9.6.2 Biological Resources

There could be long-term, minor adverse impacts to biological resources from disturbances during increased routine boat and all-terrain vehicle operations. Long-term beneficial impacts to marine mammals would be supported by additional training and the enhancement of state enforcement capacities. Increased compliance with MMPA regulations can reduce illegal and harmful activities associated with marine mammals.

6.4.9.6.3 Socioeconomic Resources

This restoration approach could have a long-term, minor adverse impact on recreational and commercial fisheries by increasing fisher interactions with law enforcement, which could be perceived negatively by fishers. Benefits include potential health and safety benefits resulting from reductions in incidents of human injuries that can occur as a result of illegal behaviors (e.g., feeding, swimming with, or physically interacting with dolphins).

This technique may have a beneficial effect on socioeconomic resources if additional jobs are created as a result of increased enforcement. No construction activities are anticipated as a consequence of this restoration approach that would adversely affect cultural or historic resources.

6.4.9.7 Reduce Injury and Mortality of Marine Mammals from Vessel Collisions

This restoration approach focuses on reducing vessel collisions with marine mammal species in the Gulf of Mexico by developing and implementing a comprehensive mitigation strategy. This strategy may include techniques such as time/area-sensitive changes to vessel routes and speeds, mariner training, and mariner and recreational boater outreach and education. Passive acoustics, tagging, and predictive modeling are additional useful tools that help inform effective mitigation to reduce vessel collisions with marine mammals (cetaceans) in the Gulf of Mexico. Providing incentives, establishing agreements, and providing edcuation and outreach can help reduce these uncertainties.

Techniques that would implement modifications to vessel routes and speeds would have project-specific impacts and require place-based evaluation. This level of specificity is not proposed in this Draft PDARP/PEIS. For this reason, these impacts are discussed in general terms. Project-specific impacts would be evaluated in a subsequent restoration plan and project-specific tiered NEPA evaluation.

6.4.9.7.1 Physical Resources

Few adverse or beneficial effects to physical resources are expected from this restoration approach. Reduced vessel speeds should reduce engine noise levels generally, although sounds may be emitted for longer periods of time. As such, minor adverse impacts to ambient noise conditions may be anticipated. Changes to vessel routes would redistribute the impacts of vessel traffic on air quality and water quality and could result in minor adverse impacts to air quality and water quality if vessel operating time is increased.

6.4.9.7.2 Biological Resources

This restoration approach could result in minor, indirect adverse impacts to biological resources associated with minor decreases in water quality due to increased vessel use, since there would be reduced vessel traffic in areas of marine mammal aggregations. Long-term beneficial effects to marine mammal populations, particularly Bryde's whales, would be observed with a reduction of marine mammal injury and mortality from vessel collisions. The population of Bryde's whales in the northern Gulf of Mexico is very small with markedly low genetic diversity. As such, any reduction in injury or mortality from vessel collisions is important for this population. Reductions in vessel collisions would also have benefits for sperm whales, as well as small cetaceans such as bottlenose dolphins. This approach may also reduce vessel strikes of other organisms, such as sea turtles. Adopting measures to reduce the incidences of ship strikes is expected to be an effective means to reduce the number and severity of ship strikes on marine mammals and promote their population growth and recovery.

6.4.9.7.3 Socioeconomic Resources

Socioeconomic impacts of this approach are likely to vary and will depend on the characteristics and locations of implemented strategies to reduce marine mammal injury and mortality from vessel collisions. Long-term, minor to moderate adverse impacts could occur if measures disrupt recreational boat or commercial shipping practices through voluntary speed restrictions, vessel rerouting, or vessel exclusion areas. Impacts may include increased costs to recreational and commercial operators due to delays or increases in travel times that result from vessels slowing down or rerouting, vessels making multiport calls, or vessel that divert to other ports. As noted above, providing incentives, establishing agreements, and providing edcuation and outreach can help reduce impacts.

Based on the nature of the approach considered at this time, restoration techniques are not anticipated to result in impacts to cultural or historic resources.

6.4.10 Restoration Type: Birds

The following restoration approaches are proposed under the restoration type for birds:

- Restore and conserve bird nesting and foraging habitat.
- Create, restore, and enhance coastal wetlands (see Section 6.4.1.1 under the restoration type Wetlands, Coastal, and Nearshore Habitats).
- Restore and enhance dunes and beaches (see Section 6.4.1.4 under the restoration type Wetlands, Coastal, and Nearshore Habitats)
- Create, restore, and enhance barrier and coastal islands and headlands (see Section 6.4.1.3 under the restoration type Wetlands, Coastal, and Nearshore Habitats).
- Restore and enhance submerged aquatic vegetation (see Section 6.4.8.1, under the restoration type Submerged Aquatic Vegetation).
- Protect and conserve marine, coastal, estuarine, and riparian habitats (see Section 6.4.1.5 under the restoration type Wetlands, Coastal, and Nearshore Habitats).

- Establish or re-establish breeding colonies.
- Preventing incidental bird mortality.

6.4.10.1 Restore and Conserve Bird Nesting and Foraging Habitat

This approach involves conserving and restoring target habitat areas or land parcels for bird resources. There are a variety of restoration techniques that can be used individually, or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Enhance habitat through vegetation management.
- Restore or create riverine islands.
- Create or enhance oyster shell rakes and beds.
- Promote nesting and foraging area stewardship.
- Provide or enhance artificial nest sites.
- Increase availability of foraging habitat at inland, managed moist-soil impoundments, agricultural fields, and aquaculture ponds.

6.4.10.1.1 Physical Resources

Temporary, short-term adverse impacts to existing soils, geology, water quality, and air quality are anticipated for any construction activities associated with the techniques; however, the project itself would result in long-term impacts if sediments or shells are borrowed and/or placed for construction of shell rakes or islands. Minor impacts are anticipated for activities associated with stewardship and enhancing nest sites. Impacts would be temporary and minor and limited to installation of signs, access, fences, or other means of reducing human trespass. Protecting bird habitat could have long-term benefits to geology, substrates, and water quality by preventing disturbance and loss of soil and reducing erosion. Protecting nesting and foraging habitat for birds could have indirect, long-term benefits by preventing development and disturbances, which can reduce surface water runoff and result in water quality benefits.

Creation of riverine islands and oyster shell rakes would require the use of heavier construction activities and result in minor to moderate adverse impacts to water and air quality. Placement of shells and/or borrow materials would cover existing sediments and result in moderate to major adverse impacts on those riverine and estuarine bottoms.

6.4.10.1.2 Biological Resources

Construction associated with installation of signs, access, fences, or other means of reducing human trespass may result in temporary minor adverse effects to biological resources, in the form of temporary disturbances to birds and other biota. Creation of riverine islands and oyster and shell rakes would require the use of heavier construction activities and result in minor to moderate adverse impacts to water and air quality. Placement of shells and/or borrow materials on estuarine sediments would bury

existing habitats and have moderate to major adverse impacts on those habitats by burying and replacing existing habitats.

Benefits of the proposed restoration approach include conservation of bird nesting and foraging habitat that would increase bird health and reproduction by preventing habitat loss through land conversion. Restrictions on seasonal or overall human use that could result from changes in land management would reduce habitat degradation.

Improvements in habitat associated with this approach may draw additional visitors to the area, resulting in potential indirect adverse impacts from human presence. Human disturbance can lead to failure of nests, increased egg and chick predation, or even total colony abandonment. Reducing anthropogenic disturbance in and around nesting birds by establishing buffer distances would benefit nesting success. Bird nesting and foraging habitat could be protected through the use of exclusion devices, vegetated buffers, maintenance of beach wrack, distance buffers and/or patrols by wildlife stewards, and targeted outreach and education. Managing vegetation is a common restoration technique to enhance habitat for specific bird species. Reducing vegetation on beaches, for example, can provide nesting and foraging habitat for birds such as such as snowy plover, least tern, black skimmer, and American oystercatcher. Conversely, adding vegetation can provide habitat for other bird species such as wading birds and brown pelicans. Common vegetation management methods include mechanical treatments, application of pesticides or herbicides, biological control to manage plant species, and active planting.

Some bird species nest primarily or exclusively on islands located in lakes or rivers. Creating or enhancing riverine islands will expand nesting habitat and/or increase the longevity of those islands, resulting in increases in production of the bird species using the islands. Direct placement of shell hash (oyster rakes) on beaches and using bagged blocks of living oysters to enhance or create living oyster reefs would benefit shorebirds by providing foraging, nesting, and roosting habitat for, e.g., the American oystercatcher, in particular. Intertidal oyster beds provide foraging sites at low tide, when the shellfish are accessible to oystercatchers. Oyster beds above mean high tide serve a critical function for oystercatchers by providing foraging and high-quality high tide roost sites.

Predation can be a significant source of bird mortality when nest sites or colonies are located in habitat that does not have adequate protection. Several options exist for removing or excluding predator threats to nesting birds. Predator control by nonlethal (e.g., exclusionary fencing or live-trapping) and lethal methods consistent with current management practices could be implemented at the discretion of the land-management agencies based on their evaluation of necessity and feasibility. Shoreline stewardship to emphasize the maintenance of wrack on beaches would provide benefits. Wrack refers to the accumulation of seaweed, terrestrial plants, animal remains and/or other organic debris along the high tide line of a beach that provides habitat for invertebrates, an important food source for beach-dependent birds (Dugan et al. 2000; FWS 2012). Shoreline stewardship should emphasize the maintenance of wrack and wrack production processes.

The lack of suitable nesting sites, such as those provided by tree cavities or shrub or tree platforms, can limit local tree-nesting bird densities. Providing artificial nest sites, such as nest platforms and nest boxes, can help mitigate this limitation, facilitating breeding for certain bird species. Managing flood

depth and timing of shallowly flooded impoundments, fields, ponds, and agricultural fields would benefit migrating birds.

6.4.10.1.3 Socioeconomic Resources

Minor, short-term adverse impacts could result due to construction activities. Impacts may be long-term for large projects such as island creation. However, improvements in habitat associated with this approach may draw additional visitors to the area with associated visitor spending, increasing sales and tax receipts on retail purchases.

Creating, enhancing, or restoring bird nesting habitat may result in minor (temporary disturbance) to moderate (disturbance without loss of cultural information) impacts on cultural and historic resources due to construction activities such as dredging, addition of sediments or borrow materials, and/or removal of sediments, depending on the scale of the action and site-specific characteristics. Discovery or recovery of cultural or historic resources would allow the future protection of the resource.

6.4.10.2 Establish or Re-establish Breeding Colonies

This restoration approach focuses on establishing or re-establishing bird breeding colonies through chick translocation and/or attracting breeding adults to restoration sites. This restoration approach could employ, but is not limited to, the following techniques:

- Fledgling and chick translocation to new colonies.
- Acoustic vocalization playbacks and decoys to attract breeding adults to restoration sites, which are often employed in conjunction with other restoration activities enhancing a target site for breeding birds (Jones & Kress 2012).
- Actively re-introducing seabirds to breeding areas. This is a proven technique to help mitigate losses from factors such as oil spills (e.g., (Apex Houston Trustee Council 2011; Kress 1983; Parker et al. 2007).

6.4.10.2.1 Physical Resources

Establishing nesting bird colonies could include minor ground disturbing activities such as construction of nesting platforms and vegetation management. Thus, impacts to the physical environment (geology, substrates, air quality, ambient noise levels, etc.) are anticipated to be minor.

6.4.10.2.2 Biological Resources

Establishing nesting bird colonies could result in minor, short-term disturbances to biological resources during nesting platform construction and vegetation management efforts. In particular, adverse impacts, including injury or mortality, could occur to individual birds during relocations. Areas with restored bird populations or breeding colonies may draw additional visitors to the area, resulting in potential, indirect adverse impacts from human presence. Mitigation measures such as restrictions on seasonal or overall human use would also reduce this impact.

Long-term benefits to birds are expected from this approach. Re-establishing historic breeding colonies and establishing new colonies provides additional habitat for birds.

6.4.10.2.3 Socioeconomic Resources

No adverse socioeconomic impacts are expected from implementation of projects from establishment or re-establishment of breeding colonies. Depending on the scope and scale of this restoration approach, this approach could provide benefits through increased opportunities for wildlife viewing. Areas with restored bird populations or breeding colonies may draw additional visitors to the area with associated visitor spending and increased sales and tax receipts on retail purchases.

6.4.10.3 Preventing Incidental Bird Mortality

A number of anthropogenic activities can lead to incidental bird mortality. There are a variety of restoration techniques that can be used individually, or in combination, as potential restoration projects. In addition to those techniques found in this restoration approach could employ, but is not limited to, the following techniques:

- Remove derelict fishing gear.
- Support bird rehabilitation centers.
- Reduce collisions by modifying lighting and/or lighting patterns on oil and gas platforms.
- Reduce seabird bycatch through voluntary fishing gear and/or technique modifications.

6.4.10.3.1 Physical Resources

There are no construction activities proposed under this approach. Ground-disturbing activities would be limited to actions associated with derelict fishing gear removal, and impacts to the physical environment (e.g., geology, substrates, air quality, and ambient noise levels) are anticipated to be minimal. Supporting bird rehabilitation centers may include additional traffic associated with travel to and from both injured birds and the rehabilitation center, including travel to potentially sensitive areas to retrieve injured birds. Increased traffic could adversely affect sediments by compaction for the life of the project. Long-term benefits may be anticipated as a result of reduced gear and their associated movements along the sea floor, which can disturb benthic habitat. In addition, removing gear often removes persistent plastics.

6.4.10.3.2 Biological Resources

Localized, short-term, minor adverse impacts to biological resources could occur from disturbance during the cleanup of the derelict fishing gear. Timing cleanup activities to avoid active nesting birds (e.g., during winter) would reduce this impact. Efforts to reduce seabird bycatch are not expected to increase risks to other species. Short-term, temporary impacts of bird rehabilitation support efforts may include bird disturbance and potential incidental mortality of birds (and other animals) and loss/damage of vegetation during retrieval activities.

Long-term beneficial impacts to birds are expected from this approach. Reducing mortality by removing abandoned fishing gear left in bird habitats (e.g., nets, hooks, and fishing lines) would benefit many bird species. Depending on the timing, location, and technique, species other than birds could also benefit, such as marine mammals and fish. Providing education and supporting the rehabilitation and release of birds injured from derelict fishing gear would improve survivability of affected birds. Reduction in offshore bird mortality through modifications of lighting on oil and gas platforms with bird-friendly alternatives could provide long-term benefits to many species of birds.

6.4.10.3.3 Socioeconomic Resources

Potential adverse socioeconomic impacts are expected to be minor and short-term. Providing support and education, modifying lighting, removing derelict fishing gear, and working with fishers to reduce seabird bycatch are activities that will have minor socioeconomic benefits through the local employment required for implementation. Removing derelict fishing gear could provide a minor benefit to fishers through reduced gear damage and increase safety that would result from fewer interactions with derelict gear. No adverse socioeconomic impacts to fishers are expected as seabird bycatch reduction activities would be voluntary and would not impose additional regulations or requirements on fishers.

Increased biomass of birds as a result of proposed restoration would occur, which could in turn result in increased opportunities for bird watchers and, further, long-term local economic benefit. The scale of these impacts will depend on the specific techniques implemented.

6.4.11 Restoration Type: Mesophotic and Deep Benthic Habitats

The following restoration approaches are proposed under the restoration type for mesophotic and deep benthic communities:

- Coral transplantation and placement of hard ground substrate.
- Protect and manage mesophotic and deep benthic coral communities.

6.4.11.1 Coral Transplantation and Placement of Hard Ground Substrate

This restoration approach includes placement of new hard ground substrate and coral transplantation to restore for the mesophotic and deep benthic corals and their associated communities. There are multiple techniques that can be used individually, or in combination, as potential restoration projects. Those techniques include, but are not limited to the following:

- Place substrate for coral colonization and/or fish use.
- Implement coral transplanting or fragmenting.

6.4.11.1.1 Physical Resources

Placement of hard substrate would cover soft-bottom substrate, causing a long-term, minor to moderate adverse effect to the localized area, depending on the scale of the activity. Due to the large proportion of the sea floor bottom that is soft sediment substrate compared to the more limiting hard substrate, it appears likely that the beneficial effect would outweigh any adverse impacts. The placement of each structure would result in some short-term, minor adverse impacts to the physical environment due to the disturbance of the seafloor bottom, which would temporarily suspend sediments. However, these effects would be localized and temporary. Project construction would typically require some use of heavy equipment, which would result in increased vehicle use and associated emissions causing minor adverse effects on air quality in the project vicinity due to pollutants from fuel emissions, including particulate matter, lead, and carbon monoxide (GHGs are specifically addressed in Section 6.14.1). Construction activities could also result in short-term, minor adverse impacts to ambient noise. Any air quality impacts would be localized and short in duration. Increased boat traffic caused by anglers traveling to the reef could potentially increase air pollution in the vicinity; however, increases in air pollution would be anticipated to be minimal.

6.4.11.1.2 Biological Resources

There could be long-term, minor adverse impacts to sessile and other limited movement species because the placement of substrate would injure or kill some organisms either through the placement of the substrate or through the loss in the soft bottom habitat in the area. However these effects are expected to be localized. Work activities during placement could affect the biological environment as a result of the use of equipment, displacement of substrate, and increased turbidity in the work area. Some species may leave the area during deployment activities, but they would likely return after activities cease. Short-term, minor to moderate adverse impacts to fish, turtles, and (albeit unlikely) marine mammals in the form of direct injury and/or mortality may be anticipated due to construction-related activities, including entrainment.

Long-term beneficial effects to the biological environment are expected from this technique. Enhanced availability of substrate for corals to colonize, along with increased cover through transplantation, will not only benefit these coral species but will also benefit associated reef fish as well as sessile and benthic organisms that occur at these depths. This approach could also provide benefits to fish species that associate with mesophotic and deep benthic communities.

Lionfish and orange cup coral, which are invasive species, are already present in large numbers in the Gulf and therefore will be monitored for at the sites.

6.4.11.1.3 Socioeconomic Resources

Short-term activities associated with project implementation would require transportation, construction, and/or placement of signs and/or buoys. Short-term beneficial socioeconomic impacts would be expected due to local job creation and construction needed to implement the project techniques. Long-term benefits would be anticipated as a result of increasing recreational opportunities in the project area.

Creating, enhancing, or restoring mesophotic and deep benthic habitat could result in minor (temporary disturbance) to moderate (disturbance without loss of cultural information) impacts on cultural and historic resources due to construction activities such as addition of sediments or other materials, depending on the scale of the action and site-specific characteristics. The AWOIS database and other relevant studies are available for identification of submersed resources for individual projects. Discovery or recovery of cultural or historic resources would allow the future protection of the resource.

6.4.11.2 Protect and Manage Mesophotic and Deep Benthic Coral Communities

This restoration approach focuses on establishing areas for spatially discrete management and protections for mesophotic and deep benthic communities and associated resources. Establishment of protection areas typically has a lower economic cost when compared with creation of the resources (Chapman & Julius 2005). Establishing protections for mesophotic and deep benthic communities could include expanding existing protections or designating new areas.

6.4.11.2.1 Physical Resources

Depending on the management actions that are implemented, installation of infrastructure (e.g., mooring buoys) or the removal of debris would temporarily disturb the ocean bottom. The potential adverse effects would be minor, short-term, and localized. Construction activities are anticipated to result in short-term, minor to moderate adverse impacts to air quality due to pollutants from fuel

emissions, including particulate matter, lead, and carbon monoxide (GHGs are specifically addressed in Section 6.14.1). Following construction, indirect impacts may include the increased use of the area by visitors with boats, resulting in additional increases in noise and emissions during use.

Establishing protections and associated management actions could result in long-term benefits to the physical environment by limiting future ground disturbing activities and/or infrastructure development within the protected area.

6.4.11.2.2 Biological Resources

Minor and short-term adverse effects may occur during implementation of this approach. These activities could affect the biological environment as a result of the use of equipment, displacement of substrate, and increase in turbidity in the work area. Temporary displacement of individuals from the work area or mortality of individual species may occur.

The mesophotic and deep benthic coral communities would benefit from a protective restoration project because they are sessile and therefore much more susceptible to threats like oil and gas activities, fishing activities, and marine debris. Benefits to mesophotic and deep benthic coral communities include increases in coral cover over time (Selig & Bruno 2010). Benefits to resources such as fish biomass (Edgar et al. 2011; Harborne et al. 2008) and abundance (Jeffrey et al. 2012), particularly in no-take reserves (Edgar et al. 2011; Kramer & Heck 2007), are anticipated. Although benefits to corals may require as many as 10 years after protected area establishment, long-term establishment is anticipated, similar to that which occurred in the Flower Garden Banks National Marine Sanctuary.

The designation or expansion of a protected area would benefit biological resources by protecting mesophotic and deep water communities and other resources found in the area. Other benefits could include reducing impacts due to limitations on fishing that can otherwise alter predator-prey relationships, disturb bottom habitats, and increase loss of fish biomass. Management actions within the protected area could provide benefits. For example, management actions could reduce marine debris and impacts of debris on corals and other organisms, such as entanglement of marine mammals in derelict fishing gear, and fish that can be incidentally caught in “ghost” fishing gears. Management actions may also include increasing setbacks of oil and gas infrastructure, limits on bottom-tending fishing gear, limits on anchoring and the discharge of pollutants, removal of marine debris such as derelict fishing gear, and invasive species removal, all of which would improve habitat for mesophotic and deep benthic coral communities.

6.4.11.2.3 Socioeconomic Resources

Designation or expansion of a protected area may restrict some activities within certain areas. However, overall, it would likely improve populations of marine organisms and subsequently increase recreational enjoyment of those resources. Long-term, moderate adverse impacts could occur. These impacts would be associated with restrictions within a protected area that limit access to resources (e.g., restrictions on bottom-tending fishing gear (Suman et al. 1999).

The designation or expansion of a protected area and associated management actions would benefit the socioeconomic environment by improving opportunities for tourism and recreation in these areas. Any

increase in visitation for recreation or tourism could in turn result in positive long-term regional economic impacts due to increased visitor spending in affected areas.

6.4.12 Restoration Type: Oysters

One approach is proposed for Oysters, which focuses on restoring and supporting healthy oyster communities. This approach is described further below.

6.4.12.1 Restore Oyster Reef Habitat

This restoration approach focuses on the restoration, creation, and enhancement of oyster reef habitat, resilient oyster populations, and diverse benthic and fish communities. Oysters are considered “ecosystem engineers” for their role in creating reefs that modify, through their physical presence, the surrounding environment while also providing habitat, refuge, and foraging areas for many other species including benthic organisms and fish (Coen & Luckenbach 2000; Powers et al. 2009; VanderKooy 2012; Wong et al. 2011). Oysters are most abundant in shallow, semi-enclosed water bodies (less than 12 meters in depth) in areas where salinity levels are between 15 and 30 parts per thousand (VanderKooy 2012). Successful restoration of oysters depends on three major factors: 1) appropriate site conditions (e.g., firm substrate, salinity, wave energy, and water quality); 2) adequate supply of oyster larvae to recruit to available cultch material; and 3) adequate amounts of substrate for recruitment (i.e., clean, unburied cultch in suitable habitat) (Brumbaugh & Coen 2009; Cake Jr. 1983; Powell & Klinck 2007). Multiple restoration techniques are available for use, either individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Restore or create oyster reefs through placement of cultch in nearshore intertidal and subtidal areas.
- Construct living shorelines.
- Enhance oyster reef productivity through spawning stock enhancement projects such as planting hatchery raised oysters, relocating wild oysters to restoration sites, oyster gardening programs, and other similar projects. Develop a network of oyster reef spawning reserves.

6.4.12.1.1 Physical Resources

Short-term, minor adverse impacts on physical resources would be anticipated as a result of cultch placement. Short-term, minor adverse impacts on air quality and noise would be anticipated during cultch placement associated with construction activities. Long-term, minor adverse impacts on air quality and noise would be expected through emissions and noise associated with increased recreational and commercial use of the restored oyster habitat. Short-term, minor adverse impacts on geology, substrates, water quality, air quality, and noise could result from activities such as anchoring marker buoys and signs for reserve areas. The installation of infrastructure could have short-term, minor adverse impacts on water quality, including increased turbidity and reduced water clarity.

Land-based construction of hatchery facilities could result in short-term, minor to moderate impacts to soils and water quality. Operation of these facilities could result in long-term, minor to moderate

impacts to water quality associated with wastewater discharges from the facilities. Impacts would be dependent on site-specific conditions and the specific design and approach used for facilities.

Long-term benefits to substrates would be anticipated as a result of the placement of oyster shell or other suitable substrate for oyster recruitment. Placement of reefs may reduce wave energy reaching shorelines, which may reduce wave energy and erosion of shorelines and stabilize substrates. Long-term benefits to water quality could also occur due to increased filter feeding by oysters.

6.4.12.1.2 Biological Resources

Short-term, minor impacts to biological resources could occur during placement of cultch or substrate required for living shorelines, which could cause short-term increases in turbidity, reducing water clarity (and photosynthetically available light), increasing crab predator abundance and subsequent predation on oyster spat, and burial of existing benthic communities. Anchors installed in a reserve for buoys or signs would result in long-term, minor loss of habitat in the footprint of the anchor. Short-term, minor to moderate adverse impacts to fish, turtles, and (albeit unlikely) marine mammals in the form of direct injury and/or mortality may be anticipated due to cultch placement activities, including entrainment.

Creation of oyster habitat would support increased populations of oysters, which would be a long-term beneficial impact. Long-term benefits of the created/restored reef include foraging and nursery habitat and refuge for numerous finfish and shellfish.

Land-based construction of hatchery facilities could result in short-term and long-term, minor to moderate impacts to biological resources during project construction. These impacts would be associated with land clearing, construction activities, and vehicle use; however, these impacts will depend on site-specific conditions. Operation of these facilities could have long-term, minor to moderate impacts to biological resources, which would be related to wastewater discharge.

Long-term benefits to other organisms, including marine mammals, sea turtles, fish, and birds are also anticipated due to the oyster reef role as “ecosystem engineer.” Reefs provide protection, habitat, foraging, and propagation grounds for these organisms. Oyster reefs also dissipate wave energy and improve water clarity, in turn, benefiting SAV and marshes.

6.4.12.1.3 Socioeconomic Resources

This approach could result in minor to moderate, short-term and long-term adverse impacts to human use within the areas designated as oyster reserves; this designation will remove these areas from potential harvest. This is expected to be a short-term, minor adverse effect, as oyster harvesters should begin to see increased oyster recruitment to fished reefs over the long term, due to the increased supply of oyster larvae to the system provided by the reserves.

Long-term beneficial socioeconomic impacts would be expected from implementation of this restoration approach by ultimately increasing recreational and commercial shellfish harvest opportunities. Restoration could increase the natural productivity of the shallow water area, thereby improving the quality of habitat and increasing oyster recruitment, potentially leading to increased revenue from commercial and recreational activities. Impacts to infrastructure and cultural resources resulting from the implementation of this restoration approach are dependent on site-specific conditions associated with a project proposed for implementation.

This approach could include short-term benefits to the local economy through an increase in employment and associated spending in the project area during construction activities. Hatchery operations would result in long-term, minor economic benefits from employment and maintenance spending. Construction of a living shoreline would provide socioeconomic benefits by reducing the risk of potential hazards, such as storm surges, and improve shoreline integrity. The scope and scale of these impacts would be evaluated on a site-specific and project-by-project basis, similar to other restoration approaches.

Impacts to cultural resources resulting from the implementation of this restoration technique are dependent on site-specific conditions associated with a proposed project. Restoring oyster reef habitat could result in minor (temporary disturbance) to moderate (disturbance without loss of cultural information) impacts on cultural and historic resources that may be located in area of the restoration. Discovery or recovery of cultural or historic resources would allow the future protection of the resource.

6.4.13 Restoration Type: Provide and Enhance Recreational Opportunities

The following restoration approaches are proposed under the restoration type for lost recreational use and are discussed below:

- Enhance public access to natural resources for recreational use.
- Enhance recreational experiences.
- Promote environmental stewardship, education, and outreach.

The following approaches are also proposed under this restoration type; these impacts have previously been discussed in Section 6.4.1 Restoration Type: Wetlands, Coastal and Nearshore Habitats:

- Create, restore, and enhance coastal wetlands.
- Restore oyster reef habitat.
- Create, restore, and enhance barrier and coastal islands and headlands.
- Restore and enhance dunes and beaches.
- Restore and enhance submerged aquatic vegetation.
- Protect and conserve marine, coastal, estuarine, and riparian habitats.

6.4.13.1 Enhance Public Access to Natural Resources for Recreational Use

This restoration approach focuses on creating new or improved access to natural resources for recreational purposes. Access to recreational areas can be improved by enhancing or constructing infrastructure (e.g., boat ramps; piers; boardwalks; dune crossovers; camp sites; educational/interpretive spaces; navigational channel improvements and dredging; safe harbors; navigational aids; ferry services; rebuilding of previously damaged or destroyed facilities; promenades; trails; roads and bridges to access natural resources; and marina pump out stations). Improved public access could also be accomplished by providing or improving water access in publicly owned areas (e.g., parks and marinas), which might also increase boating safety. The construction and operation of boat ramps, piers, or other infrastructure could occur on publicly owned lands. Larger-scale infrastructure improvements such as a ferry service or the construction or improvement of roads and bridges could

also serve to improve access to natural resources. Enhancing public access would also include targeted acquisition of land parcels to serve as public access points.

6.4.13.1.1 Physical Resources

Depending on the location and intensity of construction necessary to implement various improvements to infrastructure, short-term and long-term, minor to moderate adverse impacts on the physical environment could result from projects that enhance public access. For example, construction of a dock or pier to provide increased public access could result in short-term impacts on turbidity and sediments during construction. Possible minor adverse effects could also include temporary, localized impacts on air and noise quality from increased vessel traffic during construction.

The potential for long-term, minor to moderate adverse impacts exists depending on the use and placement of bulk-heading in association with certain infrastructure improvements (e.g., boat ramps, roads and bridges). Bulkheading has the potential for localized disruption of sediment dynamics. The purchase of access rights, easements, and/or property could result in long-term, minor impacts on soils if the lands were previously vacant and require installation of trails or other access infrastructure.

Depending on the types of recreation encouraged and the increase in usage of a land conservation site, long-term, minor adverse impacts to the physical environment are possible due to increased vehicle or boat usage in the vicinity of the site. For example, an increase in noise could occur with increased recreational use on a land parcel resulting in long-term, minor adverse impacts.

Efforts to enhance public access, through land acquisition or conservation easements, could also allow beach and dune migration and sediment migration in response to future climate and weather, which would have long-term beneficial effects on geology and substrates. Conservation could also allow for upland migration as sea level rises and could limit development encroachment. Wetland habitats landward of the beach could benefit from adjacent beach and dune area protection because these areas provide protection from storm surge and reduce erosion. Acquisition of land, or conservation easements, would increase the amount of land that could be managed for reducing stormwater runoff, sediments, and contaminants, thereby directly benefiting water quality.

6.4.13.1.2 Biological Resources

Short-term, minor to moderate adverse impacts on biological resources could result from improving recreational opportunities through enhancements to infrastructure. Short-term impacts associated with the construction or enhancements of certain types of infrastructure (e.g., boat ramps or bridges) are possible due to potential changes in sediment dynamics and would be site-specific. Other adverse impacts could include the short-term displacement of animals, including protected species such as beach mice, and the change of habitats from natural areas to built environments. Much of this infrastructure is or can be located in sensitive resources areas such as occupied beach mouse habitat, gulf sturgeon critical habitat, and EFH. Therefore, specific project design must consider the potential impacts on these resources and include BMPs and other mitigation measures to avoid adversely affecting sensitive natural resources. In-water construction activities may cause entrapment of marine mammals, sea turtles, and other protected species; however, use of best practices should mitigate this risk.

Depending on the intensity of recreational use, an increase in human and/or vehicular traffic on a land conservation tract could cause overall long-term, moderate adverse impacts to the biological resources. Added disturbance associated with human and vehicular presence could disrupt biological resources. Conservation measures could be taken in order to reduce the stress on these resources. Additional piers could cause harm or mortality to marine mammals and other organisms from fishing gear entanglements or ingestion, as well as from people illegally feeding dolphins from piers.

Adverse impacts could also occur as a result of increased fishing mortality from recreational fishing.

Improved access to resource-based recreational opportunities (e.g., bird watching) furthers the public's appreciation and understanding of the species and the habitats they need for survival. This awareness could bring long-term, minor beneficial impacts to biological resources as the public further supports conservation and wildlife management efforts. Conservation or acquisition of natural land resources can have long-term beneficial impacts on adjacent terrestrial systems and nearby marine ecosystems. This approach would reduce the amount of natural land being converted to uses that could introduce invasive species, pollutants, sediments, or contaminants to nearby systems; as well as serving as a buffer between stressors and vulnerable ecosystems, resulting in long-term benefits to existing plant and animal resources.

6.4.13.1.3 Socioeconomic Resources

Preserving habitat by acquisition of property or through conservation easements could permanently limit the amount and type of development permitted, and the management and intensity of use on these properties would likely change. Land conservation or acquisition may result in restrictions on public access in areas where public access had previously been allowed, which could reduce recreational opportunities, although given the specific intent of this approach to improve recreational opportunities, this effect is anticipated to be minor for these projects. Projects that result in changes in ownership and/or permitted uses could affect property taxes and have broader regional economic impacts resulting from changes in visitor spending in the region. Land acquisition could have a minor to moderate impact on socioeconomic resources due to changes in visitor spending and tax impacts. However, the transfer of fee title to lands and the creation of conservation easements are transactions negotiated or arranged between willing parties and, as such, are not expected to give rise to adverse socioeconomic impacts to those who choose to engage in such transactions.

If private lands are opened for recreational use, this could be beneficial. The conservation of land would result in long-term beneficial effects to socioeconomic resources due to improved aesthetics and opportunities to view, catch, or hunt wildlife. Similarly, the tourism sector could benefit from any additional trips or spending induced by restoration or protection of terrestrial and marine ecosystems.

Further, the acquisition of coastal land for conservation easements could mitigate some of the economic impacts of expected sea level rise by preventing development that would be at risk from future storm surges or flooding.

The enhancement or construction of infrastructure would have long-term beneficial impacts on the socioeconomic resources of the surrounding area. This restoration approach would also improve socioeconomic resources by providing public access. Improvements in recreational opportunities that

result from infrastructure enhancement have the potential to create localized increases in business opportunities and have long-term beneficial impacts.

Long-term benefits to cultural resources resulting from implementation of this restoration approach would be dependent on site-specific conditions. If cultural resources are present in a specific area, conservation of land would protect the resource from future impacts (e.g., due to development or construction).

6.4.13.2 Enhance Recreational Experiences

This restoration approach focuses on enhancing the public's recreational experiences. The experience of recreational activities such as swimming, boating, diving, bird watching, beach going, and fishing can vary depending on the appearance and functional condition of the surrounding environment in which they occur. There are a variety of restoration techniques that can be used individually, or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Place stone, concrete, or permissible materials to create artificial reef structures.
- Enhance recreational fishing opportunities through aquaculture.
- Reduce and remove land-based debris.

6.4.13.2.1 Physical Resources

This restoration approach may have short-term, minor adverse impacts on geology and substrate resulting from sediment disturbance from dredging and filling associated with activities such as placement of artificial reef structures and construction of aquaculture facilities. The soil and sediment disturbance from these activities could also result in short-term, minor impacts to water quality. The use of land- and marine-based construction equipment could result in short-term, minor adverse impacts to air quality and noise.

6.4.13.2.2 Biological Resources

Artificial reef placement could result in short-term, minor adverse impacts via benthic fauna disturbance. There could be additional adverse impacts to fauna if increased fishing occurs at the restoration site. Depending on the structure used, limited durability can have adverse impacts if pieces of the structure become detached. This poses the risk of environmental damage to surrounding habitats, especially during storm events.

Construction of aquaculture facilities could result in short-term, minor impacts to biological resources located at or adjacent to the construction site. Aquaculture could produce long-term, minor to moderate adverse impacts if hatchery-reared fish negatively affect the genetic diversity of the wild stock and/or affect the balance of the fish community. Additionally, adverse impacts could occur through introduction of diseases or competition with wild species, along with potential effects on habitat or protected and sensitive marine areas (NOAA 2015). See the discussion in Chapter 5, Appendix 5.D, Section D.8.2.1, explaining how the "Responsible Approach" would be a component of stock enhancement projects. Beneficial impacts could occur if the survival of finfish or shellfish leads to an increase in fish or bivalve densities without displacing wild organisms.

This restoration approach provides direct benefits to recreational users including nearshore and offshore fishing, beach use, and bird watching. Long-term beneficial impacts on biological resources are expected from the reduction of land-based debris. These benefits could accrue by reducing marine wildlife entanglement, injury, or death (CCC 2011).

Long-term beneficial impacts could occur if artificial reefs provide habitat for fish. Whether the availability of new habitat will serve to increase fish and/or invertebrate biomass or will only serve to concentrate organisms at the site is likely dependent on where the reef is sited and how it is designed (NOAA 2015).

Long-term beneficial impacts could result for habitats such as wetlands, shorelines, and water column if land-based debris was removed. Sensitive benthic habitats, including corals, oyster reefs, and SAV beds, would also benefit from less debris reaching coastal and offshore waters.

6.4.13.2.3 Socioeconomic Resources

Short-term, minor adverse impacts could occur due to construction activities or infrastructure changes associated with enhancing recreational experiences. Short-term, minor adverse impacts in the immediate area could occur during construction through 1) limiting recreational activities near the construction area in order to protect public safety, 2) temporarily increasing road or vessel traffic due to movement of construction vehicles, and 3) adversely affecting aesthetics due to the presence of construction equipment or changes to the surrounding environment. Changes to infrastructure could occur as the local, existing infrastructure expands to meet the needs of a growing or new hatchery.

Impacts to cultural resources and infrastructure would be project-specific and dependent upon site-specific conditions. Potential long-term, moderate adverse impacts to cultural resources could occur if artifacts are located at project sites.

This restoration approach is intended to provide benefits to recreational users, including nearshore and offshore fishing, beach use, and bird watching. Socioeconomic benefits would include increased access to recreational opportunities and enhanced experiences due to infrastructure improvements. Improving access and condition of visitor areas could result in long-term beneficial impacts, including an increase in beach use, an increase in recreational fishing, and increases in other resource uses that could result in an economic uplift in the surrounding area. Short-term beneficial impacts could occur to socioeconomic resources due to construction activities (e.g., dredging, artificial reef placement, and aquaculture facility construction), which would increase employment and spending in the surrounding area.

Debris removal could result in long-term beneficial socioeconomic impacts, as described earlier in Section 6.4.5.1(Gear Conversion and/or Removal of Derelict Fishing Gear to Reduce Impacts of Ghost Fishing), including reductions in beach closures, vessel disablement, and habitat damage and improvements in navigation safety.

6.4.13.3 Promote Environmental Stewardship, Education, and Outreach

This restoration type involves providing and enhancing recreational opportunities through environmental stewardship, education, and outreach activities. There are multiple restoration techniques that can be used individually, or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- Create or enhance natural-resource-related education facilities.
- Create or enhance natural-resource-related education programs.

6.4.13.3.1 Physical Resources

Construction of educational facilities could cause short-term to long-term, minor to moderate adverse impacts to soils for the duration of construction. New facility construction projects could cause long-term, moderate adverse impacts on the geology and substrate. These impacts would be on a site-specific basis, due to the large variation of projects that could occur in this approach. For example, expanding an existing facility would have minor, short-term adverse impacts, but the permanent conversion of geology and substrate to a new facility and needed amenities, such as parking lots, could have long-term, minor to moderate impacts. Runoff during facility construction could have short-term, minor impacts on water quality. Short-term, minor impacts to air quality and noise may also occur during construction. Depending on the specific project, some research activities and interactive activities can have short-term, minor adverse impacts on soils and water resources. Increased human and vehicular traffic could cause long-term, minor adverse impacts to the physical resources including soils, water resources, and noise.

Programs developed at education centers and museums that provide education on environmental issues could beneficially affect these resources by encouraging conservation, understanding, and environmental stewardship of water resources and wildlife (NOAA 2006).

6.4.13.3.2 Biological Resources

Construction of educational facilities would result in short-term, minor adverse impacts to biological resources via ground disturbance during construction activities and long-term, minor to major adverse impacts due to replacement of habitat with hard structures and associated maintenance and increased human activity. The development of education programs or youth groups would have no direct impact, but trail building and some restoration work done by educational programs could have minor, short-term adverse impacts on the biological resources during the working phase of the project. Increased human and vehicular traffic could cause long-term, minor adverse impacts to biological resources.

Long-term beneficial impacts on biological resources could be expected from the outreach provided by educational facilities. Programs developed at education centers and museums that provide education on environmental issues could benefit these resources by encouraging conservation, understanding, and environmental stewardship of natural resources and wildlife (NOAA 2006). Overall, if these educational programs increase appreciation for, and awareness of, the status of vulnerable ecological resources in the Gulf region, implementing this technique has the potential to have a long-term, minor beneficial impact on biological resources. The benefits would result from educating youth and the local community about environmental issues in the community and beyond, habitat restoration, and conservation.

6.4.13.3.3 Socioeconomic Resources

Short-term, minor adverse impacts could occur due to construction of education facilities. Construction impacts in the immediate area could occur during construction activities through 1) limiting recreational activities near the construction area in order to protect public safety, 2) temporarily increasing road or vessel traffic due to movement of construction vehicles, and 3) adversely affecting aesthetics due to the presence of construction equipment. Impacts on cultural resources resulting from the implementation

of this restoration approach are dependent on site-specific conditions. Potential long-term, moderate adverse impacts to cultural resources could occur if artifacts are located at project sites.

Short-term benefits to the local economy could accrue through an increase in employment and associated spending in the project area during construction activities. There could be short- to long-term beneficial impacts, since new or expanded environmental stewardship, education, and outreach facilities and related educational programs would employ new workers.

Long-term beneficial impacts on socioeconomic characteristics would be expected. Museums and education centers would contribute to the quality of life of the areas where they are situated and they can attract tourism to a region and promote civic pride.

6.4.14 Preliminary Phases of Restoration Planning

This section addresses the environmental consequence considerations associated with planning, feasibility studies, design engineering, and permitting on future restoration projects. As presented in Section 6.4.15, Summary of Impacts of Alternative A, the Draft PDARP/PEIS evaluates a range of restoration approaches, enabling narrower NEPA analyses for subsequent restoration plans. These subsequent restoration plans will include project-specific actions. Subsequent restoration plans may propose a preliminary phase of a restoration project. For example additional activities such as project planning, feasibility studies, and engineering and design studies may be needed on a complex project prior to proposing it for implementation.

This preliminary phase of project planning may include activities such as characterizing the environment, determining the best restoration approach from an engineering standpoint, and predicting and comparing results and conditions with and without the project. Such activities can include a mixture of research into historical conditions, modeling of hydrologic response to the project, and creating maps and scale drawings of the project site. This may also include minimally intrusive field activities such as drilling into the soil or sediment with a soil auger, vibra-core, or hand probe to remove core samples for grain size or chemical analysis; determining existing and predicted groundwater levels and elevations; and performing geotechnical evaluation. These activities may also include archaeological studies at and around the project site, which often involve digging test pits, and collecting and documenting historic features. All of the information described above may also be required to further develop projects from a conceptual phase. Some data collection may also require permits, for example when collecting data related to threatened and endangered species.

Environmental consequences that may occur as a result of these actions are considered here and are consistent with similar considerations evaluated in other programmatic restoration plans (e.g., NOAA 2015). The completion of project planning, feasibility studies, design engineering studies, and permitting activities are intended to support the development of projects to propose in more detail in subsequent restoration plans. Preliminary planning phases can increase the effectiveness and efficiency of habitat restoration. Some preliminary phases of project planning would cause direct, short-term, minor impacts through associated fieldwork (e.g., including drilling into soil or sediment with an augur, drill rig, or other tools to remove surface, subsurface, or core samples). These impacts would be very minor and localized to the project site given how small such areas are in relation to an overall project area. Temporary

impacts to the biological and physical environment also could include short-term, temporary disturbance of habitats and species; minor emissions from vehicles; and minor disturbance to terrestrial, estuarine, and marine environments. In cases where the appropriate permit or other environmental review has been secured (e.g., for photographing, handling, or disturbing listed species) or determined not necessary (e.g., certain minor, temporary disturbance of marine mammals that does not constitute harassment), minor impacts to certain protected and managed resources also could occur and be considered minor.

For subsequent restoration plans that propose a preliminary project phase where environmental consequences fall within the range of impacts evaluated in this subsection, a tiered NEPA analysis would not be needed for the particular proposed project. In those cases, the subsequent restoration plan can reference back to this PEIS and state that no additional tiered NEPA analysis is required (see Section 6.17, NEPA Considerations and Tiering Future Restoration Planning). Project-planning actions for preliminary project phases fall within the scope of the analysis of this PEIS where such proposals have adverse impacts equal to or less than those analyzed here. Although information gathered may inform future projects, the outcome of the preliminary phases does not commit the Trustees to future actions. Specifically, once a preliminary phase of project planning has been completed, the proposal to implement the project would be included in a subsequent restoration plan and associated NEPA analysis.

6.4.15 Summary of Impacts of Alternative A

As part of this PEIS, potential long- and short-term, physical, biological, and socioeconomic impacts of restoration under the program alternatives are evaluated. The generally qualitative level of detail of the evaluation is commensurate with the programmatic planning-level decisions to be made.

Restoration approaches are focused on a habitat type (e.g., wetlands, coastal, and nearshore habitats); improving water quality; groups of similar species (e.g., marine mammals, shore and nesting birds, sea turtles, pelagic highly migratory fishes, reef fishes, and SAV); and enhancing recreational opportunities. Beneficial and adverse, and minor, moderate, or major impacts are anticipated as a result of Alternative A, depending on the specific characteristics of the projects ultimately proposed in subsequent restoration plans, including the size, location, design, operation, and other aspects of future project development. However, there are some similarities in impacts across resources. For example, benefits to physical, biological, and socioeconomic resources are typically long-term and result from restoration of habitats, species, or recreational uses intended as a result of the action. Adverse impacts are generally short-term in duration, such as disturbances associated with construction activities. Long term adverse impacts include impacts to in geology and habitat as a result of conversion of habitat from one type to another that occurs as part of restoration activities. Impacts to each of these resource categories are briefly summarized below.

6.4.15.1 Physical Resources

Impacts of restoration approaches targeting creation, restoration, and/or enhancement of coastal habitats (e.g., dunes, barrier islands, coastal wetlands) to physical resources are generally anticipated to be adverse in the short-term and long-term due to construction activities and beneficial in the long term due to restoration of sustainable and resilient coastal systems. For example, large-scale restoration

activities may include construction over multiple years and would be considered long-term for purposes of this Draft PDARP/PEIS. These adverse impacts would be minimized by best practices. The long-term benefits to the physical resources outweigh the short-term, minor impacts and include restored freshwater flows, sediment, and nutrient loads; restored sediment dynamics and deltaic processes; and overall coastal resiliency.

Several restoration approaches focus on species or groups of species, for example, reef and highly migratory pelagic fish, the Gulf sturgeon, sea turtles, birds, and marine mammals. Impacts to physical resources for these approaches are fewer, of smaller intensity, and localized in comparison to habitat restoration. These restoration approaches include reducing bycatch and bycatch mortality using particular hooks, increasing the use of bycatch reduction devices, preserving areas for foraging, nesting, and/or spawning activities, and restricting access to areas (sanctuaries) or time periods (bluefin tuna spawning period). Short-term, minor adverse impacts for species-directed approaches may include 1) localized sediment/substrate disturbances due to actions such as marine debris removal or installation of signs or buoys to reduce trespass and 2) air quality and/or ambient noise impacts due to increased vehicle emissions. The benefits to the physical environment as a result of these restoration actions are typically minor and include ocean and shoreline disturbance due to removal of marine debris and minor improvements to water and air quality due to reduced or restricted development.

6.4.15.2 Biological Resources

Adverse impacts to biological resources as a result of restoration approaches are short- and long-term and minor to moderate to major. Adverse impacts are typically a result of replacement of existing habitat by the newly created or restored habitat (e.g., burial with sediment for dune creation), displacement or loss of species due to habitat replacement, or injury or mortality due to direct interaction or entrainment during restoration activities (e.g., construction or processing equipment). An example of a short-term, temporary disturbance would be displacement of fish and benthic invertebrates during construction and the return and recolonization of organisms following construction activities. Benefits to biological resources are long-term and will increase habitat for foraging, nesting, and spawning; reduce bycatch and mortality of bycatch among fish, sea turtles, birds, and marine mammals; or reduce disturbance to resources such as mesophotic corals, oyster reefs, and SAV beds.

Habitat restoration approaches that create, restore, or enhance habitat have a minor to moderate to major adverse impact on existing habitats being replaced. For example, restoration of marsh habitats may require dredging to restore hydrologic and hydraulic connectivity, as well as sediment borrow and placement for establishment of vegetation at appropriate elevations. Short-term, minor adverse impacts anticipated include reduced water quality, air quality, and ambient noise conditions primarily due to construction in water, wetlands, and on land. Long-term major adverse impacts include loss of existing habitats (e.g., open water or land) and commensurate losses of vegetation and animals associated with the replaced habitats. Benefits of the marsh restoration would be long-term and significant with respect to sediment supply source, water quality improvements, fish and wildlife habitat (nursery, foraging, spawning), as well as opportunities for recovery of particular listed species.

Restoration approaches include limiting access within discrete areas, reducing bycatch and bycatch mortality, improving response and rescue abilities, revegetation, and predator control. Adverse impacts of these approaches are typically associated with incidental injury or mortality that would occur with or

without the restoration (e.g., entrainment despite bycatch reduction devices, bycatch despite use of circle hooks instead of J-hooks, illegal oyster harvesting, and incidental injury or mortality to animals during already established rescue/response activities). Long-term benefits to these resources are often a result of reducing mortality and increasing chances of reproduction among individual organisms that, combined with other management actions (such as access restrictions, quotas, and closed fishing seasons), would have population level benefits.

6.4.15.3 Socioeconomic Resources

The magnitude and duration of socioeconomic impacts will depend on the scale of the actions chosen and site-specific characteristics such as location, presence of cultural resources in the project area, and regional availability of substitutes (e.g., recreational opportunities or alternative employment).

Few, if any, major adverse impacts to socioeconomic resources are expected to result from the restoration approaches. For example, potential major adverse socioeconomic impacts include impacts to landowners in the immediate areas of diversions implemented to restore and preserve Mississippi-Atchafalaya River processes. Barrier removal to restore sturgeon spawning habitat may result in minor to major adverse socioeconomic-related impacts to the water supply for agriculture or municipal uses, transportation, flood protection, and hydropower supply, depending on the size and designated use of the barrier that is removed.

In addition, many of the restoration approaches have potential for minor to moderate, long-term adverse impacts on fishing and other recreational activities due to changes such as use of alternative gear, repose, quota shifting, or restrictions on areas available for activities. Voluntary incentivized participation in restoration approaches such as reduced trapping or fishing would at least partially mitigate the adverse impacts of reduced income for individuals. Industries such as shipping and energy could be affected if noise restrictions are enacted. Construction activities associated with the restoration approaches may result in short-term limitations on public access, resulting in economic impacts due to reduced visitation and spending.

Numerous socioeconomic benefits are expected to result from the restoration approaches included in Alternative A. Over the long term, restoration approaches will improve the health of wildlife and fish populations, which in turn leads to increased opportunities for wildlife viewing and fishing. Regional economic benefits are expected as a result of increased tourism and recreation due to restoration of barrier islands and beaches and other important habitats. In addition, construction associated with the restoration approaches will result in short-term regional economic benefits due to increased employment and spending. Finally, the restoration approaches will provide a very important socioeconomic benefit by reducing the risk of potential hazards, such as storm surges, and improving shoreline integrity.

6.5 Evaluation of Direct and Indirect Environmental Consequences for Other Alternatives

This section considers the environmental consequences of Alternatives B, Resource-Specific Restoration; C, Continue Injury Assessment and Defer Comprehensive Restoration, and D, Natural Recovery/No Action. This section draws on the evaluation of Alternative A, above, to provide a higher level summary of potential environmental consequences for these alternatives.

6.5.1 Alternative B: Resource-Specific Restoration

Alternative B would establish a resource-specific restoration portfolio based on the Trustees' programmatic goals, purpose, and need. Alternative B seeks to maximize benefits to individual resources and human uses based on close, well-defined relationships between injured resources and the restoration types. This alternative is focused on restoring injured natural resources as directly as is practical. Because Alternative B comprises the same restoration types as Alternative A, the description of Alternative B does not repeat the information for each restoration type just presented in Section 6.4, Evaluation of Environmental Consequences of Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative). Although the restoration types that make up Alternative B are the same as those described under Alternative A, there are important distinctions in how the Trustees could implement restoration between Alternatives A and B.

Alternative B would emphasize the restoration types associated with living coastal and marine resource restoration with correspondingly less emphasis on wetland, coastal, and nearshore habitat restoration. Alternative A has a primary focus on implementing restoration actions that provide the benefit of ecosystem linkages and the ability to compensate for inferred or unquantified injuries as well as the connectivity among resources, habitats, and human uses. This means that there is an emphasis on coastal habitat restoration in Alternative A. Alternative B has a focus on restoring living coastal and marine resources. Although ancillary benefits may be provided for ecosystem linkages under Alternative B, these are not a primary consideration for this alternative. Therefore, coastal habitat restoration is a component but not the focus of Alternative B.

Under both Alternatives A and B, the Trustees would implement monitoring, assessment, and scientific support activities to evaluate the response to restoration and to better inform ongoing restoration and management decisions within an adaptive management framework. Likewise, both Alternatives A and B would factor in contingencies to address future unknown conditions, given the unprecedented scale of restoration required and the number of years that it will take to implement this plan.

Overall, Alternative B would focus on resource-specific restoration, shifting the restoration and funding allocation emphasis from the goal of Restore and Conserve Habitats to the goal of Replenish and Protect Living Coastal and Marine Resources. Although restoration of living coastal and marine resources may include some habitat restoration, the amount of habitat restoration that would be implemented is less certain than in Alternative A. Since the restoration portfolio under this alternative relies on the same approaches as Alternative A with a different emphasis across restoration types, the potential environmental consequences, including the direct, indirect, and cumulative impacts of the approaches could be the same as those summarized in Section 6.4.15, Summary of Impacts of Alternative A.

However, the environmental consequences of Alternative B would be expected to reflect relatively less of those impacts associated with the approaches under the Wetlands, Coastal, and Nearshore Habitat restoration type and more of those impacts associated with approaches under the goal of Replenish and Protect Living Coastal and Marine Resources.

6.5.2 Alternative C: Continue Injury Assessment and Defer Comprehensive Restoration Planning

Alternative C defers development of a comprehensive restoration plan until greater scientific understanding of the injury determination is achieved. This alternative could include the restoration types identified for Alternatives A and B, which are described in Section 5.5, Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative), but also could include refinements to those restoration types or a change in focus across the restoration types. Although approved Early Restoration projects would continue, no further NRDA restoration would be conducted until the additional injury assessment is completed and a corresponding restoration plan developed. Under Alternative C, the allocation of funding to restoration could be substantially less because injury assessment costs would reduce the total amount available for restoration. As a result, it would be expected that less restoration would occur, and correspondingly fewer environmental consequences (particularly fewer beneficial impacts) associated with that restoration implementation would also result.

This alternative might increase the potential for more directly targeted restoration projects. However, further study may not substantially change the understanding of the nature or extent of certain injuries regardless of the length of time or amount of funding devoted to further study. This is due to the inherent difficulties in studying many oceanic systems and the time that has already passed since the spill. Although further study might be able to provide more certainty to the injury quantification, the Trustees do not expect that the increased degree of certainty would substantially change the Trustees' restoration approach.

Deferring restoration planning in favor of continued assessment would cause substantial delays in restoration implementation beyond Early Restoration, which would lead to further losses in natural resources and their services. This further study may not substantially change the understanding of the nature or extent of certain injuries regardless of the length of time or amount of funding devoted to further study. Additionally, the reduction in funds available for restoration (due to expenditure on continued assessment) would result in Alternative C not providing as much benefit to injured resources as Alternative A or B.

6.5.3 Alternative D: Natural Recovery/No Action

NEPA requires consideration of a no-action alternative as a basis for comparison of potential environmental consequences of the action alternatives. OPA regulations also require that "trustees must consider 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)).

As discussed in Chapter 5, Section 5.8, under the Natural Recovery/No Action alternative, the Trustees would not prepare a restoration plan to undertake any additional restoration for injured natural resources or to compensate for lost services. Early Restoration would be the only restoration implemented under NRDA under this alternative—no additional restoration would be done by Trustees. This alternative does not meet the purpose and need for restoration of injured resources and services.

Under this alternative, Trustees 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. Under this alternative, resources affected by the spill would remain injured for a longer period of time. For example, SAV in the Chandeleur Islands that would see beneficial impacts from approaches to restore and enhance the resource may otherwise recover naturally, but over the course of two to 10 years, rather than over a more expedited period. Similarly, marine mammals would see accelerated benefits from restoration through enforcement capabilities; reductions in commercial bycatch; reduced illegal feeding and harassment; or enhanced capacity to respond to stranded, injured, and entangled individuals. Without such restoration, natural recovery of these resources could require decades.

A "no-impact" conclusion could be made for the Natural Recovery/No-Action alternative because this alternative would largely result in a continuation of the conditions described in Chapters 3, Ecosystem Setting and 4, Injury to Natural Resources, and there would be neither associated funding costs, nor any economic benefits with the No Action Alternative. However, as the benefits to resources intended as a result of implementing the PDARP/PEIS would not be realized, and given that technically feasible restoration approaches are available, the alternative is not further compared against the other action alternatives.

This alternative would have no beneficial impacts to elements of the environment, as natural resources would recover more slowly or not recover without restoration. Under the no-action alternative, some habitat recovery could result from other federal actions (such as ESA-related actions), but not from the federal action being evaluated in this PEIS. When analyzed in combination with other past, present, and reasonably foreseeable future actions, Alternative D is not expected to contribute to short-term or long-term, cumulative adverse impacts to physical resources, biological resources, or socioeconomics.

6.6 Cumulative Impacts

6.6.1 Potential Cumulative Impacts

The CEQ regulations to implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects, plans, and programs. 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 nonfederal) or person undertakes such other actions" (40 CFR § 1508.7). As stated in the CEQ handbook, *Considering Cumulative Effects* (CEQ 1997a), 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. Cumulative impacts should be considered for all alternatives, including Alternative D, No Action. Although the restoration types are expected to be the same under both Alternative A and B, the distribution and level of use of the approaches implemented under Alternative B would be different. Without an understanding of this distribution, it would be speculative to estimate a distinction between potential cumulative impacts of Alternatives A and B. As stated above, Alternative C represents a deferment of restoration activities, and it would be expected that less restoration would occur and correspondingly fewer environmental consequences associated with that restoration implementation would also result. Therefore, for the evaluation at this programmatic level, cumulative impacts presented here reflect an estimate for Alternatives A, B, and C.

Cumulative Impacts

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 nonfederal) or person undertakes such other actions" (40 CFR § 1508.7).

Consistent with CEQ regulations, the cumulative impacts analysis considers the environmental impacts of proposed alternatives when added to impacts of past, present, and reasonably foreseeable future actions throughout the northern Gulf of Mexico region.

The following analysis considers cumulative impacts from a programmatic perspective. The following section describes the multistep approach used for evaluating cumulative impacts in this document.

6.6.2 Methodology for Assessing Cumulative Impacts

The analyses of cumulative impacts are typically accomplished using four steps:

- **Step 1—Identify resources affected.** In this step, each resource affected by the alternatives is identified. It is important to note that when direct and indirect impact analyses conclude that a particular resource is not affected, a cumulative impact analysis for that resource is not required. The following cumulative impact analysis is organized in tables corresponding to specific affected resources.

- **Step 2—Establish boundaries.** In order to identify the past, present, and reasonably foreseeable actions to consider in the cumulative impact analysis, affected-resource-specific spatial and

temporal boundaries must be identified. The spatial boundary is the area where past, present, and reasonably foreseeable future actions have taken place, are taking place, or could take place and result in cumulative impacts to the affected resource when combined with the impacts of the alternatives being considered. The temporal boundary describes how far into the past and forward into the future actions should be considered in the impact analysis. Appropriate spatial and temporal boundaries may vary for each resource.

- **Step 3—Identify a cumulative action scenario.** In this step, the past, present, and reasonably foreseeable future actions to be included in the impact analysis for each specific affected resource are identified. These actions fall within the spatial and temporal boundaries established in Step 2. The following programmatic analysis groups specific actions by cumulative action categories. These action categories are listed and described below. The more specific actions within each action category are listed in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.
- **Step 4—Cumulative impact analysis.** This final step develops the analysis in the context of the affected environment of the incremental impact of the Alternative (X), when added to the impacts from applicable past, present, and reasonably foreseeable future actions (Y), to understand the potential cumulative impacts to an affected resource (Z), or, where the affects may interact and/or be additive, that is, X + Y = Z.

6.6.3 Identification of Resources Affected and Boundaries of Analysis (Steps 1 and 2)

6.6.3.1 Resources Affected

The following section identifies the affected resources evaluated for cumulative impacts. In this Draft PDARP/PEIS, cumulative impacts include all of the resources identified in the environment/affected resources sections.

6.6.3.2 Spatial Boundary of Analysis

As discussed above, the spatial boundaries used to provide the necessary context for the cumulative impact analysis typically are defined based on the particular resource being assessed. For the purpose of this analysis, the spatial boundary includes those areas where restoration approaches described in each alternative likely could occur, which is assumed to be the northern Gulf of Mexico region. Although many of these resources consist of highly migratory species, and restoration efforts may be conducted in habitats that occur outside of the Gulf of Mexico, at this stage of programmatic review an estimation of potential cumulative impacts beyond the Gulf of Mexico would be so speculative that such an analysis would not be informative. Cumulative impact analysis in tiered environmental reviews will address this potential at that more appropriate scale.

6.6.3.3 Temporal Boundary of Analysis

Guidance on determining what actions to consider in the cumulative impact analysis comes from a variety of sources. CEQ has produced several guidance documents, including a memorandum entitled "Guidance on Consideration of Past Actions in Cumulative Effects Analysis" (CEQ 2005). This CEQ document states that consideration of past actions is only necessary in so far as it informs agency

decision-making. Typically, the only types of past actions considered are those that continue to have present effects on the affected resources.[8] This present effect will dictate how far into the past actions are considered and how, typically, the impacts of these past actions are largely captured in the discussion of the affected environment for each resource. The guidance states that "[a]gencies are not required to list or analyze the effects of individual past actions unless such information is necessary to describe the cumulative effect of all past actions" (CEQ 2005). Agencies are allowed to aggregate the effects of past actions without delving into the historical details of individual past actions. Courts have agreed with this approach, giving deference to CEQ's interpretation of NEPA and stating that, as it relates to past actions, NEPA requires "adequate cataloging of relevant past projects in the area" (Ecology Center v. Castaneda, 574 F.3d 652, 667 [9th Cir. 2009]).

Present actions are those that are currently occurring and also result in impacts to the same resources within the same spatial boundary that the alternatives affect. Reasonably foreseeable future actions are those actions that are likely to occur and affect the same resource as the proposed alternatives. The determination of what future actions should be considered requires a level of certainty that they will occur to ensure that the consideration of future actions is not overly speculative. This level of certainty could be met by a number of factors such as the completion of permit applications, the subject of approved proposals or planning documents, or other similar evidence.

Determining how far into the future to consider actions is based on the impact of the alternatives being considered. Once the impacts of the alternatives are no longer experienced by the affected resource then future actions beyond that need not be considered. For this Draft PDARP/PEIS, future actions were identified as those actions likely to be initiated prior to finalization of the DARP and actions that may occur beyond finalization of the DARP that were determined to be reasonably foreseeable and likely to contribute to the overall cumulative impacts.

6.6.4 Categories of Cumulative Actions in the Northern Gulf of Mexico Region (Step 3)

In order to effectively consider the potential cumulative impacts at a programmatic level, the Trustees identified categories of similar actions. Within these categories, examples of actual past, present, and reasonably foreseeable future actions are described (see also Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis). There may be additional small-scale activities not currently identified; however, the categories and their associated described actions provide the necessary information to fully understand the potential cumulative impacts that may be experienced by specific affected resources.

6.6.4.1 Restoration Related to the *Deepwater Horizon* Spill

There are a number of past, present, or future restoration efforts and actions related to the spill. Although the full extent of these restoration actions are not known at this time, multiple large-scale

[8] The cumulative impact assessments (both programmatic and project level) appropriately do not separately analyze the effects of the spill itself.

restoration efforts occurring in the Gulf are anticipated in coming years. A brief description of some of these programs is presented below.

6.6.4.1.1 RESTORE Act

The Resources and Ecosystems Sustainability, Tourist Opportunities and Revived Economies of the Gulf Coast States (RESTORE) Act of 2012 established a Gulf Coast Ecosystem Restoration Council (GCERC or Council). In 2013, the Council adopted an Initial Comprehensive Plan (GCERC 2013), which provides a framework to implement a coordinated, Gulf Coast regionwide restoration effort in a way that restores, protects, and revitalizes the Gulf Coast. In August 2015, the Council released a draft Initial Funded Priorities List (FPL) for ecological restoration and protection projects selected according to the Council's Initial Comprehensive Plan. The draft FPL contains proposals for projects across 10 watersheds, and has a total estimated cost of approximately $183 million. If approved, these projects will be funded with deposits made to the Trust Fund as a result of a settlement agreement between the United States and Transocean Deepwater. Future Council restoration will depend on the availability of funding. The RESTORE Act dedicates 80 percent of any civil and administrative penalties paid under the Clean Water Act to the Gulf Coast Restoration Trust Fund for ecosystem restoration, economic recovery, and tourism promotion in the Gulf Coast region.

6.6.4.1.2 Restoration Under Other Criminal Plea Agreements

In 2012 to 2013, BP and Transocean each entered into criminal plea agreements with the United States Justice Department. Substantial funding under those plea agreements is being directed to:

- **The Gulf Environmental Benefit Fund.** This fund is administered by the National Fish and Wildlife Foundation, to restore and protect Gulf Coast natural resources. During the first three years (2013-2015) of the agreement, 51 projects worth nearly $395 million were supported through the Gulf Environmental Benefit Fund. Projects were selected after consultation with state and federal resource agencies and are distributed across the five Gulf states (NFWF n.d.).

- **The North American Wetlands Conservation Fund.** This fund is designated for "wetlands restoration and conservation projects" located in the Gulf or projects that would "benefit migratory bird species and other wildlife and habitat" affected by the oil spill. Specific projects are not yet identified.

- **The National Academy of Sciences.** This funding is intended to enhance the safety of offshore drilling to protect human health and the environment. The money will be used for a 30-year "program focused on human health and environmental protection, including issues relating to offshore oil drilling" and the production and transportation of hydrocarbons in the Gulf and the Outer Continental Shelf. The National Academy of Sciences announced the funding of 12 exploratory grants under its Gulf Research Program, totaling more than $1.5 million, on September 9, 2015.[9] Additional Relevant Environmental Stewardship and Restoration Activities

[9] Description of these exploratory grants by the National Academy of Sciences is available at: *http://nas.edu/gulf/index.html*.

6.6.4.1.3 Resource Stewardship Activities

Stewardship activities within the Gulf of Mexico region include a diverse range of federal, state, local governmental, nongovernmental, and private coastal and marine habitat protection and restoration projects. These stewardship activities are intended to provide benefits to Gulf of Mexico resources, many of which are the same resources and services affected by the *Deepwater Horizon* oil spill. Similarly, implementation of some stewardship activities would have impacts to many of the same resource components being evaluated under the *Deepwater Horizon* restoration. This section includes programs that focus on land protections and conservation easements and those that focus on habitat restoration. For information on examples of specific past, present, and future actions see Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

6.6.4.1.4 Water Quality Improvement Programs

The condition of the Gulf of Mexico ecosystem reflects water quality impacts from urban development, industry, transportation, agricultural runoff, atmospheric deposition, and other sources throughout the Gulf of Mexico watershed. A number of authorities are in place to reduce the discharge of contaminants that enter the Gulf of Mexico (e.g., OPA; Clean Air Act; Clean Water Act; Farm Bill; National Park Service Organic Act; and the Marine Protection, Research and Sanctuaries Act). Water quality improvement programs and authorities seek to address human uses that result in water quality degradation in the Gulf of Mexico and are expected to continue into the foreseeable future in an effort to restore water quality conditions.

Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis, describes many of the federal, state, and local projects and programs related to water quality improvement that have occurred in the past and present and are expected to continue into the future.

6.6.4.2 Military Operations

Military operations in the Gulf of Mexico are undertaken primarily by the U.S. Air Force and the U.S. Navy within federally designated areas for the purposes of training personnel, as well as research, design, testing, and evaluation activities. There are 18 U.S. military bases along the northern Gulf of Mexico and more than 40 military warning areas designated by the U.S. Air Force, for conducting various testing and training missions, and the U.S. Navy, for various naval training and testing operations (BOEM 2012).

The Gulf of Mexico Range Complex is a combined air, land, and sea space that provides realistic training areas for U.S. Navy personnel. In coastal and marine areas, the Gulf of Mexico Range Complex includes military operations areas and overlying special use airspaces, the Naval Support Activity Panama City Demolition Pond, security group training areas, and supporting infrastructure. Four offshore operating areas located in the northern Gulf of Mexico—Corpus Christi, New Orleans, Pensacola, and Panama City—define where the U.S. Navy conducts surface and subsurface training and operations. The Security group training areas are also located in marine waters of the Gulf of Mexico Range Complex. There are two group training areas: off the coast of Panama City, Florida, and off the coast of Corpus Christi, Texas. These areas are used for machine gun and explosives training. Naval Support Activity, Panama City, Florida, conducts diver training and underwater research, as well as ship salvage and submarine rescue exercises (BOEM 2012).

U.S. Fleet Aircraft operated by all Department of Defense (DoD) units train within a number of special-use airspace locations that overlie the military operations areas, as designated by the Federal Aviation Administration. Special-use airspaces are largely located offshore, extending from 3.5 miles out from the coast over international waters and in international airspace (BOEM 2011). Examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

6.6.4.3 Marine Transportation

When the potential cumulative impacts associated with marine transportation are considered, port development, shipping and maritime services, and associated navigation, channel construction and maintenance are important. The Gulf of Mexico coast encompasses a comprehensive system of ports and waterways that provide the facilities and logistics for import and export of foreign and domestic goods, as well as intermodal transport between vessels, trucks, and railroads. Major shipping lanes run throughout the Gulf ecosystem, and the volume and value of shipping and port activities is continually increasing. Marine transportation planning to improve traffic congestion and other shipping issues has been occurring. Additional examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis. Some of these include the following:

Present action. The M-10 Marine Highway Corridor includes the Gulf of Mexico; the Gulf Intracoastal Waterway; and connecting commercial navigation channels, ports, and harbors from Brownsville, Texas, to Jacksonville and Port Manatee, Florida. The M-10 connects to other Marine Highway Corridors: the M-49 Corridor at Morgan City, Louisiana; the M-65 Corridor in Mobile, Alabama; and the M-55 in New Orleans, Louisiana.

- **Future action.** For example, U.S. Department of Transportation's Maritime Administration (MARAD) has identified marine corridors, projects, and initiatives to establish all water routes to serve as extensions of the surface transportation system. These corridors are planned to ease traffic congestion and reduce air emissions resulting from truck traffic along the interstates and other roadways, particularly within the major cities along established transportation routes (MARAD n.d.).

- **Future action.** Corridor traffic via land is expected to grow significantly by 2025, and the M-10 route would provide a maritime route that could ease congestion (including freight rail congestion) around Houston and along 400 miles of the corridor already operating at an unacceptable level of service (MARAD n.d.). The M-10 route is expected to provide public benefits by reducing congestion on roadways, reducing GHG emissions, and reducing road maintenance costs (MARAD n.d.).

- **Future action.** Two projects are associated with the M-10 Marine Highway Corridor. The Cross Gulf Container Expansion Project will expand the frequency and capacity of container-on-barge traffic. The Gulf Atlantic Marine Highway Project is a public-private venture that would distribute containers between the Gulf, mid-Atlantic, and south Atlantic coasts of the U.S via the M-10 and M-95 Corridors from Brownsville, Texas, to South Carolina. These marine routes provide benefits over the corresponding land routes; for example, the Cross Gulf water route

between Brownsville, Texas, and Port Manatee, Florida, is about 600 miles shorter than the land route (Fritelli 2011). The construction of additional vessels could help to expand the use of these marine highways.

- **Ongoing and future actions.** In anticipation of the potential for increased maritime commerce as a result of the 2014 expansion of the Panama Canal, ports along the Gulf of Mexico have signed Memoranda of Use with the Panama Canal Authority and are expanding and upgrading their infrastructure. Memoranda of Use have been signed between the ports of Freeport, Galveston, Houston, and the Port of Corpus Christi Authority, Texas; Port of New Orleans, Louisiana; Alabama State Port Authority; Mississippi State Port Authority at Gulfport; and Broward County (Port Everglades Department), Manatee County Port Authority, and Tampa Port Authority, Florida (Panama City Port Authority 2015). Many of the ports are deepening and widening channels, improving existing facilities, and developing new terminals, berths, and container storage areas in order to attract additional markets and maintain competitiveness.

6.6.4.4 Energy Activities

The Gulf of Mexico is one of the most important regions in the United States for energy and chemical resources. This sector is supported by numerous facilities, including platform fabrication yards, shipyards, support and transport facilities, pipelines, pipe coating yards, liquefied natural gas (LNG) processing and storage facilities, refineries, petrochemical plants, and waste management facilities, among others. Examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

6.6.4.4.1 Offshore Oil Production

Management of the oil and gas resources of the Outer Continental Shelf (OCS) is governed by the Outer Continental Shelf Lands Act (OCS Lands Act), which sets forth procedures for leasing, exploration, development, and production of those resources. The Bureau of Ocean Energy Management (BOEM) within the Department of the Interior is responsible for implementing the requirements of the act related to preparing the leasing program (BOEM 2012). Pursuant to the OCS Lands Act, BOEM has prepared *A Proposed Outer Continental Shelf Oil and Gas Leasing Program for 2012-2017* (BOEM 2012). The five-year proposed program includes a schedule of offshore oil and gas lease sales on the U.S. OCS. Of the 15 proposed lease sales included in the proposed program, 12 are in the Gulf of Mexico and include the following:

- **Western Gulf of Mexico.** A total of five annual areawide lease sales began in the fall of 2012 that made available all unleased acreage.

- **Central Gulf of Mexico.** A total of five annual areawide lease sales beginning in the spring of 2013 that make available all unleased acreage.

- **Eastern Gulf of Mexico.** A total of two sales, in 2014 and 2016, in areas of the eastern Gulf of Mexico.

Transportation for most oil and gas from the Gulf of Mexico Proposed Planned Leasing Program is anticipated to be accomplished by extending and expanding existing offshore pipeline systems with some transport from barge and shuttle tankers.

6.6.4.4.2 Offshore Natural Gas Facilities

LNG facilities on the OCS are currently in various stages of the permitting process. One offshore LNG terminal operated off the coast of Louisiana until approximately 2012. Although the future of offshore LNG terminals is uncertain, the U.S. Coast Guard provides the current status of applications (USCG 2015).

6.6.4.4.3 State Oil and Gas Activities

All Gulf states, with the exception of Florida, have active oil and natural gas programs in offshore state waters and onshore areas. Texas and Louisiana have the highest levels of oil and gas activity in the Gulf of Mexico, and this activity is predicted to continue into the foreseeable future. Oil production in Texas in recent years has increased from 443 thousand barrels (Mbbl) in 2000, to 727 Mbbl in 2012. Texas' natural gas withdrawals increased from 5.6 billion cubic feet in 2000, to 7.1 billion cubic feet in 2012. Over 167,000 oil wells and over 102,000 gas wells are active in the state. Louisiana oil production increased from 2010 to 2011 by 6 percent (to 68.1 Mbbl) and gas production, by 33.4 percent (to 2.9 trillion cubic feet [Tcf]). Oil production is forecasted to decrease slightly through 2030; however, natural gas production is expected to increase through 2020 to over 3 Tcf and then decrease to approximately 2.5 Tcf by 2030 (LDNR 2015). Mississippi Development Authority (MDA) has issued proposed rules for seismic exploration and state leasing for offshore oil and gas drilling in the state's coastal waters. Drilling of new wells for oil and gas in Alabama has increased substantially from 1999 to 2012, and the number of producing wells increased to 6,929 in 2010, up from 564 wells in 1970 (Alabama Oil and Gas Board 2011). Expansion of offshore oil and gas production is increasing shipbuilding along the Alabama coast due to demand for offshore supply and rig-tending vessels and infrastructure associated with repairing drilling rigs (GCERTF 2011). Examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

6.6.4.5 Marine Mineral Mining, Including Sand and Gravel Mining

BOEM has authority to lease mineral resource deposits within coastal Gulf waters for phosphate, oyster shell, limestone, sand and gravel, and magnesium (MMS 2004). However, sand and gravel are the minerals that are primarily mined in the Gulf of Mexico. Limitations of sand, both in terms of the correct composition and quantity, can be an issue in many areas of the Gulf. The BOEM Marine Minerals Program (MMP) is observing an increase in the requests for OCS sand because suitable state resources are becoming depleted. Examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

6.6.4.6 Dredged Material Disposal

Materials from maintenance dredging are primarily disposed offshore on existing dredged-material disposal banks and in ocean dredged-material disposal sites (ODMDS), which are regulated by EPA. Additional dredged-material disposal areas for maintenance or new-project dredging are developed as needed and must be evaluated and permitted by USACE and relevant state agencies prior to construction.

The USACE beneficial use of dredge materials program makes available dredged materials disposed offshore for potential beneficial uses to restore and create habitat and beach nourishment projects. Virtually all ocean dumping that occurs today is maintenance dredging of sediments from the bottom of channels and water bodies in order to maintain adequate channel depth for navigation and berthing.

There are four small ODMDSs located offshore in Louisiana and Mississippi along open-water stretches of the main Gulf Intracoastal Waterway between Louisiana and Mississippi: in Louisiana, ODMDS 66 (1,593 acres; 645 hectares); and in Mississippi, ODMDS 65A (1,962 acres; 794 hectares), 65B (815 acres; 330 hectares), and 65C (176 acres; 71 hectares) (USACE 2009). Dredged materials from the Gulf Intracoastal Waterway are sidecast at these ODMDS locations.

There are two primary federal environmental statutes governing dredge material disposal. The Marine Protection, Research, and Sanctuaries Act (also called the Ocean Dumping Act) governs transportation for the purpose of disposal into ocean waters. Section 404 of the Clean Water Act governs the discharge of dredged or fill material into U.S. coastal and inland waters. EPA and USACE are jointly responsible for the management and monitoring of ocean disposal sites. The responsibilities are divided as follows: 1) USACE issues permits under the Clean Water Act and the Marine Protection, Research, and Sanctuaries Act; 2) EPA has the lead for establishing environmental guidelines/criteria that must be met to receive a permit under either statute; 3) permits for ODMDS disposal are subject to EPA review and concurrence; and 4) EPA is responsible for identifying recommended ODMDS.

The USACE's Ocean Disposal Database reports the amount of dredged material disposed in ODMDSs by district (USACE 2015).

The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention), to which the United States is a signatory, requires annual reporting of the amount of materials disposed at sea. USACE prepares the dredged material disposed portion of the report to the International Maritime Organization, the yearly reports for which are posted on USACE's Ocean Disposal Database (USACE 2015). Examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

6.6.4.7 Outer Continental Shelf (OCS) Sand Borrowing

BOEM has issued 31 noncompetitive negotiated agreements to access OCS sand resources. The OCS Program continues to focus on identifying sand resources for coastal restoration, investigating the environmental implications of using those resources, and processing noncompetitive use requests.

Approximately 76 million cubic yards of sand are expected to be needed for coastal restoration projects as reported by the Gulf of Mexico OCS Region's Marine Minerals Program.

The boundary between the OCS and Texas state waters (9 nautical miles [10 miles; 16 kilometers]) allows that some offshore sand is within the jurisdiction of the state; however, the easternmost portion of the shelf in Texas state waters is relatively devoid of beach-quality sand deposits. The Texas General Lands Office, in cooperation with BOEM and Texas Bureau of Economic Geology, has investigated the potential for use of Heald and Sabine Banks as borrow for beach restoration projects; however, no specific projects have been identified. Some uncertainty exists for how much OCS sand offshore of the state of Louisiana will eventually be sought. The Louisiana Coastal Area Ecosystem Restoration plan potentially may use up to 60 million cubic yards; however, state/federal cost-sharing agreements and federal funding levels for project design and construction is uncertain (CPRA 2012). There has been a recent increase in state-funded projects in Louisiana requesting OCS sand resources. It is anticipated that this trend of state-led projects will continue into the future as restoration funding is made available

directly to the state through the Coastal Impact Assistance Program (CIAP), restitution (i.e., fines and penalties associated with the *Deepwater Horizon* event), and the Gulf of Mexico Energy Security Act (GOMESA). Examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

6.6.4.8 Coastal Development and Land Use

The landscape of the northern Gulf of Mexico has been altered and will continue to be altered as a result of land use activities that include coastal development and redevelopment for residential, commercial, industrial, recreational, agricultural, and forestry purposes. Changes in land use patterns that result from a need for economic development, such as tourism-related coastal development, intensify demand on coastal resources and can lead to environmental degradation and natural hazard risks. Increasing populations within coastal communities, such as resort and retirement communities, can change the historical water-dependent land uses, which include public access for recreation, commercial and recreational fishing, and ship-building. Examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

Based on building permit numbers, construction of single-family homes in Louisiana and Texas decreased after 2006. Mississippi and Alabama continue to have a low, but consistent, level of building permits issued (NOAA 2011a). Development within the South Padre Island and Port Aransas areas of Texas and the Tampa Bay region of Florida is principally residential and mixed use development; however, many construction projects have been canceled or reduced in scope or have had build-out timeframes extended as a result of the post 2008 economy.

Seasonal and retirement communities have also grown within the Gulf of Mexico region, especially in the Gulf communities of Florida and Texas. Over 500,000 seasonal homes are located within the region, distributed as follows: Texas (14 percent); Louisiana (7 percent); Mississippi (1 percent); Alabama (4 percent) and Florida (74 percent) (NOAA 2011a).

6.6.4.9 Fisheries and Aquaculture

The Gulf of Mexico Fishery Management Council (GMFMC or Council) is one of eight regional fishery management councils established by the Fishery Conservation and Management Act of 1976. The Council prepares fishery management plans that are designed to manage fishery resources within the 200-mile limit of the Exclusive Economic Zone (EEZ) in the Gulf of Mexico. The Council has authority to regulate fisheries in federal waters, including aquaculture. Federal waters begin 3 to 9 nautical miles offshore and extend to the outer edge of the 200-mile EEZ. From Texas and Florida, federal waters begin 9 nautical miles out, and from Mississippi, Louisiana, and Alabama, federal waters begin 3 nautical miles out (GMFMC 2013).

The Council manages and regulates commercial and recreational fishing in federal waters. It sets closures for sensitive areas and marine sanctuaries; quotas; trip limits; and minimum size limits for coastal migratory fish, reef fish, shellfish, and other fish. For recreational fishing, the Council regulates fishing activities, including setting of seasons and closures; permitting activities; and setting of daily limits, bag limits, and minimum size requirements. Currently no aquaculture activity occurs within federal waters, although an Aquaculture Fishery Management Plan (FMP) has been developed that

would permit and regulate these operations. Examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

The Council and NMFS developed the Aquaculture FMP to maximize benefits to the nation by establishing a regional permitting process to manage the development of an environmentally sound and economically sustainable aquaculture industry in federal waters of the Gulf of Mexico. The primary goal of the proposed aquaculture permitting program is to increase the maximum sustainable yield and optimum yield of federal fisheries in the Gulf of Mexico by supplementing the harvest of wild-caught species with cultured products. Although the Aquaculture FMP has been approved, it has not been implemented. Implementation regulations are currently being finalized for the Aquaculture FMP.

If the Aquaculture FMP is implemented, up to 20 offshore aquaculture operations would be permitted in the Gulf over the next 10 years, with an estimated annual production of up to 64 million pounds (NOAA 2015). The plan prohibits shrimp farming and only allows the raising of native Gulf species.

Various state agencies are responsible for regulating recreational, commercial, and aquaculture activities within state waters, including Florida Fish and Wildlife Conservation Commission, Florida Department of Environmental Protection, Florida Department of Agriculture and Consumer Service Division of Aquaculture; Alabama Department of Conservation and Natural Resources Marine Resources Division; Mississippi Department of Environmental Quality; Mississippi Department of Marine Resources; Mississippi Department of Agriculture and Commerce; Mississippi Department of Wildlife, Fisheries, and Parks; Louisiana Department of Wildlife and Fisheries; and Texas Parks and Wildlife Department. These agencies manage, monitor, and regulate commercial fisheries and aquaculture within their state waters. The agencies' activities include licensing and permitting activities and operations; leasing of coastal submerged land for aquaculture; setting of catch limits, quotas, and seasons; regulation of harvesting and processing; and provision of technical assistance.

As described on their website, the Gulf States Marine Fisheries Commission was established by an act of Congress (P.L. 81-66) in 1949 as a compact of the five Gulf states. Its charge is "to promote better utilization of the fisheries, marine, shell and anadromous, of the seaboard of the Gulf of Mexico, by the development of a joint program for the promotion and protection of such fisheries and the prevention of the physical waste of the fisheries from any cause." The Commission is composed of three members from each of the five Gulf states. Those members include the head of the marine resource agency of each state, a member of the legislature, and a citizen with knowledge of marine fisheries appointed by the governor.

6.6.4.10 Tourism and Recreation

The tourism industry in the Gulf region offers a wide variety of activities such as golfing, gambling, beach recreation, boating, ecotourism (wildlife watching, birding, visiting parks, beaches and wildlife refuges, and scenic viewing), hunting, and fishing. Many of these activities are directly dependent upon the coastal ecosystems of the Gulf of Mexico. Access to the waters, beaches, wildlife, and scenic views in each of the five Gulf states supports a multibillion dollar regional tourism industry (Gulf Coast Ecosystem Restoration Task Force 2011). Examples of actions considered in this cumulative action category are found in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis.

Efforts to promote and increase tourism in the Gulf states include marketing and advertising incentives, casino resort development, wildlife and cultural festivals, and golf tournaments. There are activities for increasing and diversifying passive recreation and tourism in the Gulf. These activities include birding, wildlife viewing, cultural heritage enjoyment, and water trails that can be traversed by canoe or kayak.

6.6.5 Cumulative Impact Analysis (Step 4)

The following section and associated tables describe the cumulative impacts of the alternatives being considered when combined with other past, present, and reasonably foreseeable future actions. The analysis provided below considers the impacts of the cumulative action categories and their corresponding actions identified above and in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis. The analysis recognizes that in most cases the contribution to the cumulative impacts for a given resource from implementing the action alternatives would be difficult to discern at a broad programmatic level across the Gulf of Mexico given the context and intensity of impacts from the other past, present, and future actions. In many situations, implementation of one of the action alternatives would likely help reduce overall long-term adverse impacts by providing a certain level of offsetting benefits, especially when considered in concert with other actions of similar nature (e.g., stewardship programs or non-NRDA restoration). The cumulative impact analysis is evaluated by affected resource.

There are several ways in which effects may come together to result in cumulative effects. For purposes of the following analysis, cumulative effects have been identified and may fall under one or more of the following categories, which are defined, for purposes of this analysis, as follows:

- **Additive adverse or beneficial effect.** Occurs when the negative or beneficial impact on a resource adds to effects from other actions.
- **Synergistic (interactive) adverse effect.** Occurs when the net adverse impact on a resource is greater than the sum of the adverse impacts from individual actions (this could also result in a different type of impact than the impact of the individual impacts; e.g., increased temperature discharges in water when added to increased nutrient loading can result in reduced dissolved oxygen—a different impact).
- **Synergistic (interactive) beneficial effect.** Occurs when the net beneficial impact on a resource is greater than the sum of the benefits from individual actions (this could also result in a different type of impact than the impact of the individual impacts).
- **Countervailing effect.** Occurs when the net effect of two or more actions, when combined, have an overall effect that is less than the sum of their individual effects.

In the following sections, the analysis is organized by resource and alternative. The analysis follows the pattern below:

- Direct and indirect effects of the proposed action (X).

- The impacts to the resources from applicable past, present, and reasonably foreseeable future actions (Y).
- Potential cumulative impacts of the alternative and applicable actions on an affected resource (Z), where the effects may interact and be additive; more simply, X + Y = Z.

6.6.5.1 Physical Environment

The nearshore marine environment in the northern Gulf of Mexico comprises the coastline and the inner continental shelf, extending to depths of 600 feet. The offshore marine environment consists of portions of the Gulf of Mexico that are more than 600 feet deep, including the outer shelf, continental slope, and abyssal plain. Coastal transition areas typically include tidally influenced areas (e.g., marshes, estuaries, and coastal wetlands). Finally, upland environments are those habitats that are adjacent to coastal transition areas but are not subject to a tidal regime or regularly inundated by water.

Construction and operation of energy and mining facilities (offshore and onshore); marine transportation facilities; commercial, industrial, and residential development in coastal habitats; and corridor improvements (hereinafter "ongoing activities") are detailed in Appendix 6.B Additional Actions for Consideration in Cumulative Impacts Analysis. These actions may alter, damage, or destroy elements in physical resources through impacts including water quality degradation, substrate disturbances, and conversion of habitats to residential, commercial, or industrial uses or other human disturbances. There are also many environmental stewardship and restoration projects that have occurred or are underway in the region that may affect physical resources (see Appendix 6.B).

The northern Gulf of Mexico region includes upland surface soils, subsurface rock features, and submerged coastal and oceanic sediments. Sediment resources are particularly important along the areas dominated by deltaic processes (e.g., Mississippi River Delta), and where land building and erosion are dynamic and dependent on the availability of sediment resources.

Gulf Coast hydrology and water quality are mainly affected by freshwater inputs (from inland waters of the Gulf of Mexico watershed) and the movement of saltwater. The quantity and rate of freshwater inputs through contributing rivers can be altered by a number of natural and anthropogenic factors such as changes in rainfall and land cover; flood control practices; spillway operation; navigation structures such as locks, dams, weirs, and other water control structures; consumption of freshwater by agriculture, municipal, and industrial interests; and the development of stormwater infrastructure. Freshwater inflows to the northern Gulf of Mexico contribute nutrients, sediments, and pollutants from upstream agriculture, stormwater runoff, industrial activities, and wastewater discharges. The influx of these constituents is further affected by currents and surface winds. In addition, the nearshore environment, including tidal marsh areas, has been physically modified (e.g., through channelization and canal construction), allowing saltwater intrusion, which affects both surface and subsurficial groundwater resources. These alterations can affect the influx of freshwater into the northern Gulf of Mexico, resulting in alterations to salinity regimes in nearshore areas, potentially increasing the frequency and magnitude of hypoxic events. On balance, the inflow of freshwater provides the freshwater and sediment inputs necessary for maintaining healthy nearshore salinity regimes and coastal landscapes, and offshore currents generally improve water quality through mixing and dilution.

However, offshore currents can also serve as a conduit for pollution that can contribute to water quality degradation.

All of the Gulf Coast counties meet the National Ambient Air Quality Standards (NAAQS) for nitrogen dioxide, sulfur dioxide, carbon monoxide, particulate matter, and lead. However, the Houston-Galveston-Brazoria area has been listed by EPA as nonattainment for existing ozone standards (EPA 2015; IPCC 2013). Large increases in natural gas production in the Gulf Coast region helped contribute to an increase in calculated 2012 CH_4 emissions in recent years (EPA 2015). National emissions in 2013 totaled 6,673 million metric tons (Mt) CO_2 Eq. This was a 2.0 percent increase from 2012 (EPA 2015). Globally, GHG emissions reached 31,734 Mt of CO_2 Eq. per year in 2012 (IEA 2014).

Noise levels in areas of the Gulf Coast region are affected by a number of ongoing activities (Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis). The primary sources of terrestrial noise in the coastal environment are transportation- and construction-related activities. In the marine environment, sounds are also introduced from marine transportation, military activities, energy development, and mineral-related activities (e.g., oil and gas exploration, drilling, and production), among others.

Alternatives A, and B include all of the previously discussed restoration approaches that are included in the wide-ranging restoration types: restoration of wetlands, coastal, and nearshore habitats, federal lands, water quality, fish, sturgeon, sea turtles, SAV, marine mammals, birds, mesophotic and deep benthic habitats, oysters, as well as recreational opportunities. Alternative C could include the restoration types identified for Alternatives A and B, but also could include refinements to those restoration types or a change in focus across the restoration types.

Impacts of restoration approaches targeting creation, restoration, and/or enhancement of coastal habitats to physical resources are generally anticipated to be adverse in the short-term and long-term due to construction activities and beneficial in the long term due to restoration of sustainable and resilient coastal systems. Adverse impacts would be minimized by best practices. The long-term benefits to the physical resources outweigh the short-term, minor impacts and include restored freshwater flows, sediment, and nutrient loads; restored sediment dynamics and deltaic processes; and overall coastal resiliency.

Several restoration approaches focus on species or groups of species, for example, reef and highly migratory pelagic fish, the Gulf sturgeon, sea turtles, birds, and marine mammals. Impacts to physical resources for these approaches are fewer, of smaller intensity, and localized in comparison to habitat restoration. Short-term, minor adverse impacts for species-directed approaches may include 1) localized sediment/substrate disturbances due to actions such as marine debris removal or installation of signs or buoys to reduce trespass and 2) air quality and/or ambient noise impacts due to increased vehicle emissions. The benefits to the physical environment as a result of these restoration actions are typically minor and include ocean and shoreline improvements due to removal of marine debris and minor improvements to water and air quality due to reduced or restricted development.

Under Alternative D, No Action, no restoration under NRDA beyond Early Restoration projects would occur. Past, present, and reasonably foreseeable future actions described above would be expected to continue. As described above, impacts of these other actions would include soil compaction and

removal, reduced soil stability, soil contamination, rutting, removal of substrates, and erosion. Countervailing impacts associated with reduced erosion or increasing sediment availability from restoration, conservation, and recovery efforts that are associated with other environmental stewardship and restoration activities in the Gulf of Mexico would also occur.

Based on information available for this analysis, Alternatives A, B, and C are not expected to contribute substantially to short-term or long-term, cumulative adverse impacts to physical resources when analyzed in combination with other past, present, and reasonably foreseeable future actions. Alternative C would delay and may reduce benefits to physical resources. Alternative D would not contribute to long-term restoration benefits to physical resources and would contribute to degradation of physical resources in the northern Gulf of Mexico ecosystem. Where appropriate, regional or site-specific cumulative impact analyses would be conducted in documents tiering from the PDARP/PEIS to address potential impacts in more detail.

6.6.5.2 Biological Resources

Biological resources include habitats, as well as the plant and animal species (living coastal and marine resources) that utilize those habitats. Habitats of the northern Gulf of Mexico injured by the spill are described in Chapter 3, Ecosystem Setting, and include habitats important for protected species that are subject to other stressors (e.g., SAV is considered a sensitive, protected habitat that has declined and provides foraging for listed sea turtles).

The biota of the northern Gulf of Mexico ecosystem are an interconnected fabric of linked habitats, including nearshore intertidal marshes, mangroves, submerged aquatic vegetation, sand beaches, and oyster reefs; the estuarine, shelf, and offshore water column (including the highly productive *Sargassum* habitat); and soft-bottom habitats, mesophotic reefs, and deep sea corals. The resources and habitats of the northern Gulf of Mexico are linked through physical processes and biological relationships. These habitats provide key functions and resources required by the high diversity of plants and animals that depend on these habitats and their interconnections. Impacts to one habitat may result in cascading effects to an array of other habitat types. For example, development in coastal transition zones may increase the volume and rates of stormwater runoff and result in excessive sedimentation in receiving water bodies, which could adversely affect biota.

The northern Gulf of Mexico is home to a host of living coastal and marine resources that include a diversity of plant and animal species. The movement of species between habitats is an important ecological characteristic of the northern Gulf ecosystem. Certain species utilize a variety of habitats for portions of their life cycle (e.g., many juvenile fish Gulf species utilize estuaries until they reach maturity when they migrate to the open waters of the Gulf of Mexico). Other species, such as migratory birds, spend only part of the year in the Gulf Coast. Some species spend the vast majority of their life cycle in a single habitat type (e.g., oysters on a reef) and may be more vulnerable to habitat destruction than other species that utilize this habitat type intermittently.

Impacts to northern Gulf of Mexico habitats from past, present, and reasonably foreseeable future actions, as described above, would also affect those living coastal and marine resources that rely on them. Actions that reduce/degrade habitat or increase/restore habitat would have corresponding impacts to the species that use those habitats.

As discussed above, Alternatives A and B include all of the previously described restoration approaches that are included in the wide-ranging restoration types: restoration of wetlands, coastal, and nearshore habitats, federal lands, water quality, fish, sturgeon, sea turtles, SAV, marine mammals, birds, mesophotic and deep benthic habitats, and oysters, as well as recreational opportunities. Alternative C could include the restoration types identified for Alternatives A and B, but also could include refinements to those restoration types or a change in focus across the restoration types.

Most Alternative A and Alternative B restoration approaches are anticipated to result in short-term, minor to moderate adverse impacts to habitat as a result of construction activities. Adverse impacts could include increased soil erosion, vegetation damage or removal, changes in water quality from turbidity and substrate disturbance from in-water work, and the potential introduction or opportunity for establishment of invasive species.

Alternatives A and B have the potential to result in long-term, minor to moderate adverse impacts to habitats adjacent to new breakwaters or other shoreline protection structures because they could change natural current patterns and sediment accretion and erosion rates, alter availability of invertebrate prey, and cause changes to erosion in offsite locations. Long-term, minor to moderate adverse impacts may also occur from habitat restoration where one habitat type is permanently converted to another target habitat type (e.g., displacement of unvegetated open water habitat to restore wetlands or oyster reefs). Since the restoration approaches under Alternatives A and B focus on restoring or protecting natural resources, the northern Gulf of Mexico is expected to largely experience long-term beneficial impacts through improved health, stability, and resiliency of habitats, including sensitive habitats such as wetlands, barrier islands, areas of SAV, and reefs. These restoration approaches could help re-establish native plant communities, stabilize substrates, support sediment deposition, strengthen shorelines, and reduce erosion, among other habitat improvements.

Under Alternative C, the allocation of funding to restoration could be substantially less because injury assessment costs would reduce the total amount available for restoration. As a result, it would be expected that less restoration would occur, and correspondingly fewer environmental consequences, particularly fewer beneficial impacts, associated with that restoration implementation would also result.

Past, present, and reasonably foreseeable future actions described above for the No-Action Alternative would be expected to continue. As described above, activities including energy and mining, coastal development and land use, military activities, and marine transportation would result in short- and long-term adverse impacts to habitats, including habitat degradation through reduced quality (e.g., reduced water quality or introduction of invasive species), habitat fragmentation, and habitat loss. Construction activities from habitat restoration and conservation and recovery efforts associated with other environmental stewardship and restoration activities would also contribute to short-term adverse impacts. However, countervailing beneficial impacts from habitat restoration and conservation and recovery efforts associated with other environmental stewardship and restoration activities in the Gulf of Mexico would also occur. These actions would likely create new or restore degraded habitats, protect habitats from fragmentation, and preserve unaffected quality habitats, especially sensitive habitats.

Based on information available for this analysis, Alternatives A, B, and C are not expected to contribute substantially to short-term or long-term, cumulative adverse impacts to biological resources when

analyzed in combination with other past, present, and reasonably foreseeable future actions. Alternative C would delay and may reduce benefits to biological resources. Alternative D would not contribute to long-term benefits of restoring biological resources. Where appropriate, regional or site-specific cumulative impact analyses would be conducted in documents tiering from the PDARP/PEIS to address potential impacts in more detail.

6.6.5.3 Socioeconomics

As described in the affected environment sections of this document, millions of people live, work, and recreate in the northern Gulf of Mexico region and, therefore, rely on the natural and physical resources the Gulf's environment provides. Land use in the region comprises a heterogeneous mix of industrial activities: manufacturing, marine, shipping, agricultural, and petrochemical industry activities; recreation; and tourism. Land management for conservation purposes also occurs at the federal, state, and local government levels, as well as on private lands.

People have lived in the coastal region of the Gulf of Mexico for more than 10,000 years. Today many unique and diverse cultures call the Gulf Coast home. These cultures, past and present, are often closely linked to the environmental and natural resources that make up the Gulf Coast ecosystem, which these restoration approaches seek to help restore. Cultural resources encompass a range of traditional, archeological, and built assets. Historic properties in the affected coastal communities date from both the prehistoric and historic periods.

Commercial fisheries represent a multibillion dollar industry in the northern Gulf of Mexico and have traditionally included finfish, shrimp, oysters, and crabs. State, federal, and international agencies regulate fishery resources within their jurisdictions. (NOAA 2015) defines aquaculture as "…breeding, rearing, and harvesting of animals and plants in all types of water environments including ponds, rivers, lakes, and the ocean." The Census of Aquaculture targets "all commercial or noncommercial places from which $1,000 or more of aquaculture products were produced and either sold or distributed during the census year" (USDA & NASS 2005). Noncommercial operations include federal, state, and tribal hatcheries (USDA & NASS 2005).

Construction and operation of energy and mining facilities (offshore and onshore); marine transportation facilities; commercial, industrial, and residential development in coastal habitats; and corridor improvements (hereinafter "ongoing activities") are detailed in Appendix 6.B, Additional Actions for Consideration in Cumulative Impacts Analysis. There are also many environmental stewardship and restoration projects that have occurred or are underway in the Gulf Coast region that may affect socioeconomics (see Appendix 6.B).

Provision of public health and safety can be complicated by large storm events such as tropical storms and hurricanes (and associated storm surges, winds, and battering waves) that have historically caused extensive damage to the shoreline as well as infrastructure such as roadways, bridges, and buildings. The Gulf's coastal communities are at increased risk for severe shoreline damage and storm surges. In addition, construction activities and increased human uses of resources can also pose risks to public health and safety.

Taken together, ongoing and likely future actions in the northern Gulf of Mexico provide benefits to a number of socioeconomic resources while also adversely affecting other resources, including commercial fisheries and recreation.

Under Alternatives A and B, proposed restoration approaches specifically directed at restoring, enhancing, and conserving resources and habitats in the northern Gulf of Mexico ecosystem would be undertaken. Alternatives A and B are anticipated to include restoration approaches that are wide ranging, including restoration of wetlands, coastal, and nearshore habitats, federal lands, water quality, fish, sturgeon, sea turtles, marine mammals, birds, mesophotic and deep benthic habitats, and oysters, as well as recreational opportunities. Few, if any, major adverse impacts to socioeconomic resources are expected to result from the restoration approaches. For example, potential major adverse socioeconomic impacts include impacts to landowners in the immediate areas of diversions implemented to restore and preserve Mississippi-Atchafalaya River processes. Barrier removal to restore sturgeon spawning habitat may result in minor to major adverse socioeconomic-related impacts to the water supply for agriculture or municipal uses, transportation, flood protection, and hydropower supply, depending on the size and designated use of the barrier that is removed. In addition, many of the restoration approaches have potential for minor to moderate, long-term adverse impacts on fishing and other recreational activities due to changes such as use of alternative gear, repose, quota shifting, or restrictions on areas available for activities. Voluntary incentivized participation in restoration approaches such as reduced trapping or fishing would at least partially mitigate the adverse impacts of reduced income for individuals. Industries such as shipping and energy could be affected if noise restrictions are enacted. Construction activities associated with the restoration approaches may result in short-term limitations on public access, resulting in economic impacts due to reduced visitation and spending.

Numerous socioeconomic benefits are expected to result from the restoration approaches included in Alternatives A and B. Over the long term, restoration approaches will improve the health of wildlife and fish populations, which in turn leads to increased opportunities for wildlife viewing and fishing. Regional economic benefits are expected as a result of increased tourism and recreation due to restoration of barrier islands and beaches and other important habitats. In addition, construction associated with the restoration approaches will result in short-term regional economic benefits due to increased employment and spending. Finally, the restoration approaches will provide a very important socioeconomic benefit by reducing the risk of potential hazards, such as storm surges, and improving shoreline integrity.

Under Alternative C, the allocation of funding to restoration could be substantially less because injury assessment costs would reduce the total amount available for restoration. As a result, it would be expected that less restoration would occur, and correspondingly fewer environmental consequences, particularly fewer beneficial impacts, associated with that restoration implementation would also result.

Other past, present, and reasonably foreseeable future activities described above under the No-Action Alternative would be expected to continue. As described above, current and future activities such as those related to ongoing coastal development and land use, commercial and recreational fishing and aquaculture, tourism, marine mineral mining, and energy development, as well as construction activities associated with stewardship, NRDA, and non-NRDA restoration activities, would result in adverse and

beneficial effects to local economies. These impacts would depend on regional economic conditions, the types of activities occurring, their economic impacts, and their location with respect to regional economies.

Based on information available for this analysis, Alternatives A, B, and C are not expected to contribute substantially to short-term or long-term, cumulative adverse impacts to socioeconomics when analyzed in combination with other past, present, and reasonably foreseeable future actions. Alternative C would delay and may reduce benefits to socioeconomics. Alternative D would not contribute to long-term benefits to recreational use and employment anticipated under Alternatives A, B, and C. Where appropriate, regional or site-specific cumulative impact analyses would be conducted in documents tiering from the PDARP/PEIS to address potential impacts in more detail.

Executive Order 12898 (February 11, 1994) states that, to the greatest extent practicable, federal agencies must "identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." As described in Section 6.16, environmental justice considerations will be conducted in documents that are tiered from this Draft PDARP/PEIS.

Chapter 7, Governance, describes a process by which periodic reviews will be conducted to evaluate the status of the PEIS and determine if supplements are necessary as a result of changing conditions. Should significant changes in the affected environment occur that render the current analysis inaccurate, a supplemental analysis may be conducted. This may include changes to the cumulative impacts analysis.

6.7 Comparison of Environmental Consequences of Alternatives

This section focuses on a comparison of the environmental consequences of the alternatives with consideration of the direct, indirect, and cumulative impact analyses presented above. This section begins with a summary of impacts for Alternative C and focuses on comparing Alternatives A and B. At this programmatic level, the Trustees find that the most meaningful distinction between the alternatives derives from the differences in environmental benefits, specifically the benefits to injured resources. Since analysis under OPA must consider the benefits of restoration alternatives to injured resources, it is helpful to refer to the OPA comparison of alternatives in Chapter 5, Section 5.9. That analysis is included here where it informs the NEPA analysis.

Under Alternative C, the Trustees would continue assessing injuries and defer development of a comprehensive restoration plan. Since the specific emphasis among restoration types and description of approaches would not be fully developed until the restoration plan is developed, an analysis of potential adverse environmental consequences of this alternative is not provided here. Alternative C would result in a delay of restoration implementation and in less available funding for restoration planning and implementation. Thus, Alternative C would not be as successful as Alternative A or B in meeting the Trustees' goals for returning the injured natural resources and services to baseline and/or compensating for interim losses.

The No-Action Alternative (Alternative D) does not meet the Trustees' goals and clearly does not provide the significant environmental benefit to injured natural resources and services that would occur through active restoration.

The Trustees next considered the comparative environmental impacts of Alternatives A and B. As described in Chapter 5, Section 5.9, Comparative OPA Evaluation of Action Alternatives, both action alternatives are composed of a restoration portfolio that 1) meets the four programmatic goals of benefiting habitat, water quality, living coastal and marine resources, and recreational use; 2) includes the restoration types identified based on injury; and 3) distributes that restoration across the five states, federal lands, and nearshore and offshore waters (see Chapter 5, Section 5.3.1, Programmatic Trustee Goals). Additionally, the alternatives meet the fifth goal by including monitoring, adaptive management, and adaptive management for unknown conditions. The Trustees would also factor in contingencies to address future unknown conditions, given the unprecedented scale of restoration required and the number of years that it will take to implement this plan.

Since Alternatives A and B are based on the same restoration types, the detailed analysis of restoration approaches in Section 6.4, Evaluation of Environmental Consequences of Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative) also serves as the detailed environmental impact analysis of the restoration approaches that make up Alternative B. However, Alternatives A and B differ in their emphasis. Alternative A emphasizes coastal habitat restoration and ecological interconnectivity. Alternative B emphasizes restoration of living coastal and marine resources.

Alternative A (Comprehensive Integrated Ecosystem Restoration) will employ an ecosystem approach toward implementing restoration with the intent of enhancing and strengthening the connectivity and productivity of habitats and resources, which will help sustain restoration gains over the long term. This

alternative emphasizes restoration of highly productive coastal habitats, which provide food and shelter for a wide array of resources affected by the spill. This alternative explicitly recognizes the importance of coastal habitats to the physical and biological interconnectivity of the northern Gulf of Mexico ecosystem and is more likely than Alternative B to address both documented and reasonably inferred but unquantified injuries. The recognition of the key role of coastal habitats helps ensure that multiple resources will benefit from restoration and that reasonably inferred but unquantified injuries are likely to be addressed. To achieve the desired portfolio of restoration approaches, the emphasis on coastal habitat restoration will be complemented by additional restoration for living coastal and marine resources and recreational uses to ensure that all injured resources are fully compensated. This combination of implementing restoration across resource types and emphasizing coastal habitat restoration plus robust monitoring and adaptive management creates a restoration portfolio that maximizes the likelihood of providing long-term benefits to resources and services injured by the spill. This alternative also emphasizes restoring habitats in combination with one another to achieve multiple, and potentially synergistic, benefits and considers restoration approaches that can produce large-scale benefits across multiple resources to support resiliency and sustainability.

Alternative B would implement more direct, resource-specific restoration, shifting the restoration emphasis from the goal Restore and Conserve Habitats to the goal Replenish and Protect Living Coastal and Marine Resources. However, since Alternative B emphasizes living coastal and marine resources and correspondingly reduces the emphasis on coastal habitat restoration, the Trustees are less certain that Alternative B would provide as much benefit for the reasonably inferred but unquantified injuries summarized in Chapter 4, Section 4.11, Injury Assessment, Summary and Assessment of Findings. The strong, but indirect, ecological linkages between habitats and species injured by the spill would be ancillary, rather than primary, benefits under Alternative B.

Alternative A provides more certainty of achieving environmental benefits in the northern Gulf of Mexico, as it provides more certainty that benefits to ecosystem linkages will occur and will restore for reasonably inferred but unquantified injuries. This analysis under NEPA closely corresponds to the alternatives analysis under OPA, and informed the Trustees' identification of Alternative A as preferred.

6.8 Cooperating Agencies

NOAA is the lead federal Trustee for preparing the *Deepwater Horizon* Draft PDARP/PEIS and has invited all Trustees (See Section 1.2 for list of designated Trustees) to act as cooperating agencies pursuant to NEPA (40 CFR § 1508.5). The federal Trustees intend to adopt this PEIS. This document is prepared in accordance with 40 CFR §§ 1500-1508, *CEQ's Regulations for Implementing NEPA, NOAA Administrative Order Series 216-6 Environmental Review Procedures for Implementing the National Environmental Policy Act*. Correspondence relating to cooperating agencies is included in Appendix 6.C, Cooperating Agency Correspondence.

Cooperating Agency

"Means any Federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment. The selection and responsibilities of a cooperating agency are described in Section 1501.6. A State or local agency of similar qualifications or, when the effects are on a reservation, an Indian Tribe, may by agreement with the lead agency become a cooperating agency." (40 CFR § 1508.5).

6.9 Compliance with Other Applicable Authorities

In addition to the requirements of OPA and NEPA, requirements of other laws may apply to the Draft PDARP/PEIS. The Trustees will ensure compliance with these relevant authorities. The authorities described below are most relevant to future proposed actions in subsequent restoration plans. Whether and to what extent an authority applies to a future project depends on the specific characteristics of a particular project, among other things. Select authorities below, e.g., ESA, may be pursued at this programmatic level to streamline future regulatory processes with other laws in the future.

The authorities listed below are the most commonly relevant to Trustees' restoration actions. An expanded list of federal laws and regulations is included in Appendix 6.D, Other Laws and Executive Orders.

6.9.1 Endangered Species Act

The purpose of the ESA is to conserve endangered and threatened species and the ecosystems upon which they depend. The ESA directs all federal agencies to utilize their authorities to further these purposes. Section 7(a)(1) requires federal agencies, in consultation with NMFS and the USFWS, to carry out programs for conservation of listed species. Restoration under this program is likely to further the conservation of listed species.

Section 7(a)(2) of the ESA requires every federal agency, in consultation with and with the assistance of the Secretaries of the Interior and Commerce, to ensure that any action it authorizes, funds, or carries out, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. Section 9 of the ESA and regulations issued pursuant to Section 4(d) of the ESA prohibit the take of listed species unless exempted by the NMFS or USFWS. To "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect listed species. This prohibition applies to federal and nonfederal parties. It is anticipated that at least some of the restoration projects may result in take. An incidental take statement (ITS) is included in formal consultations and exempts an action agency from Section 9 prohibitions as long as the action agency complies with the reasonable and prudent measures and terms and conditions of the ITS.

Information on threatened and endangered species and critical habitat designations under NMFS jurisdiction in the Gulf of Mexico is available from the following links: *http://sero.nmfs.noaa.gov/protected_resources/section_7/threatened_endangered/Documents/gulf_of_mexico.pdf* and *http://sero.nmfs.noaa.gov/maps_gis_data/protected_resources/critical_habitat/index.html*.

Information on threatened and endangered species and critical habitat designations under USFWS jurisdiction in the Gulf of Mexico is available from the following links: *http://ecos.fws.gov/ecp/*, *http://www.fws.gov/ecological-services/*, and *http://ecos.fws.gov/crithab/*.

To comply with the ESA on future project-specific actions, the Trustees will initiate consultations and conferences with the USFWS and/or NMFS on proposed projects or groups of projects that may affect

listed and proposed species and their designated or proposed critical habitats. The Trustees will develop a list of species and critical habitats that may be affected by each proposed project or group of projects, document the types of potential impacts from the proposed project to listed and proposed species and designated critical habitats, incorporate practices from Appendix 6.A, Best Practices, of this Draft PDARP/PEIS, and where necessary, propose additional project-specific avoidance and minimization measures. Based on this information, projects or groups of projects will be analyzed to determine if they 1) would have no effect on listed species, species proposed for listing, or designated or proposed critical habitat (together, “listed resources”); 2) may affect, but are not likely to adversely affect, listed resources; or 3) are likely to adversely affect listed resources.

Conference is a process of early interagency cooperation involving informal or formal discussions between a federal agency and the USFWS and/or NMFS pursuant to Section 7(a)(4) of the ESA regarding the likely impact of an action on proposed species or proposed critical habitat. Although conferences are only required by the ESA statute for proposed federal actions that are likely to jeopardize proposed species or result in destruction or adverse modification of proposed critical habitat, the Trustees will conference on proposed actions that may affect proposed species and proposed critical habitats in order to minimize or avoid adverse effects to listed species and to streamline ESA authorizations once the proposed species is listed and/or critical habitat is designated.

The status of these ESA consultations and conferences, including required conservation measures and/or best practices and design criteria, where applicable, will be included in final subsequent restoration plans prepared consistent with this Draft PDARP/PEIS (see Section 6.17, NEPA Considerations and Tiering Future Restoration Planning). A project form was established in *Deepwater Horizon* Early Restoration Phase IV to streamline information needed for consultation with USFWS and NMFS. A current version of this form can be similarly used to streamline information collection for both USFWS and NMFS for future projects.

The Trustees must comply with the procedural obligations of Section 7 of the ESA (see Chapter 7, Section 7.3, Restoration Planning). If the Trustees determine a project has No Effect on ESA-listed species and its habitat, this determination should be documented and retained in project records. If the Trustees determine that the action is not likely to adversely affect listed species or designated critical habitat, and NMFS or USFWS concurs, Section 7 consultation is complete, unless a re-initiation trigger occurs.

If NMFS or USFWS does not concur, then the project proponent will initiate formal consultation. If the project proponents determine that the action is likely to adversely affect a listed species, they will conduct formal consultation with NMFS and/or USFWS. NMFS or USFWS will provide a biological opinion and, if NMFS or USFWS determines that the project is likely to jeopardize listed species or destroy or adversely modify critical habitat, NMFS or USFWS will provide reasonable and prudent alternatives (RPAs) that will allow the project to proceed without likely jeopardy or adverse modification. It is possible that an individual project may result in jeopardy or adverse modification of critical habitat and would thus need to be modified through an RPA that avoids jeopardy and adverse modification or would need to be abandoned altogether. The incidental take statement in the biological opinion provides an exemption to take, and requires the action agency to implement nondiscretionary terms and conditions.

The Trustees may consider pursing programmatic ESA consultation at the program level that can provide some efficiency. Program level consultation, resulting in a programmatic biological opinion, examines the effects of a program on ESA-listed species and their habitat. It also provides an analysis that can be tiered from during future ESA consultations. Programmatic biological opinions offer pathways for streamlining large numbers of projects that require ESA consultation (as described above) by providing a consistent framework for submitting individual projects or groups of projects.

This Draft PDARP/PEIS is not proposing to identify or select specific projects for implementation, and consultations with USFWS and NMFS would occur as part of subsequent restoration planning. In 2015, NMFS and USFWS established new rules for programmatic consultations,[10] and the Trustees may seek a "framework" programmatic consultation with either or both USFWS or NMFS. In particular, the Trustees have been coordinating with NMFS to determine if project design criteria for restoration activities might be available for consideration in future consultations. More information on best practices currently available and those to be developed in the future by NMFS and USFWS can be found in Appendix 6.A, Best Practices.

6.9.1.1 Projects with Existing Consultations

Some projects that could be proposed as part of future restoration planning may have a completed ESA consultation that was initiated by another action agency prior to being tiered from this Draft PDARP/PEIS.

For species under NMFS jurisdiction, the Trustees will initiate a new consultation but may rely on the analysis in the previously completed consultation after determining that 1) there have not been any new species or critical habitats proposed, listed, or designated; 2) the proposed action has not changed in a manner or extent that might affect a proposed or listed species or proposed or designated critical habitat in a manner or to an extent not previously considered; and 3) no new information is available that reveals effects from the proposed action might affect species or critical habitats in a manner or to an extent not previously considered.

For species under USFWS jurisdiction, if USFWS determines that the project has not changed in scope, the pre-existing consultations will be reviewed to determine if the consultations are still valid. Specifically, projects will be reviewed to determine if 1) any new species or critical habitats have been proposed, listed, or designated; 2) the proposed action has changed in a manner or extent that might affect a proposed or listed species or proposed or designated critical habitat in a manner or to an extent not previously considered; or 3) if new information is available to reveal that effects from the proposed action might affect species or critical habitats in a manner or to an extent not previously considered. If any single criterion above is met, the consultation will be reinitiated, and, if necessary, a new consultation will be started.

If NMFS or USFWS determines an existing consultation is not valid for a project, the Trustees will initiate a new consultation.

[10] Framework and mixed programmatic consultations are described in the NMFS/USFWS May 11, 2015 ITS rule found here: *http://www.fws.gov/endangered/improving_ESA/pdf/Final%20ITS%20Rule%20Federal%20Register%205-11-2015.pdf.*

6.9.1.2 Section 10(a)(1)(A) Research Permits

The ESA and implementing regulations prohibit the take of species listed as endangered or threatened; however, Section 10(a)(1)(A) of the ESA allows NMFS and USFWS to issue permits to take species listed under the ESA for scientific purposes or to enhance the survival of the species. Permit issuance criteria require that research activities are consistent with the purposes and polices of the ESA and that such activities would not have a significant adverse impact on the species or stocks. In some circumstances, separate Section 10(a)(1)(A) authorization is not required if an incidental take statement in a biological opinion exempts the project from the ESA's take prohibitions.

6.9.2 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) as amended in 1996 created a requirement for federal agencies to consult with the NOAA NMFS when their actions or activities may adversely affect habitat identified by federal regional fishery management councils or NMFS as EFH. It is important to note projects with a positive net environmental outcome may require EFH consultation due to temporary or permanent impacts occurring during construction or implementation. For example, EFH consultation would be required if one type of EFH is lost by converting it to another type of EFH during construction of a wetland restoration or habitat improvement project.

At its most basic, an EFH consultation consists of a federal agency providing NMFS with an EFH assessment and NMFS responding with EFH conservation recommendations, followed by the federal agency's written response to the recommendations. EFH consultation is required if the action may adversely affect EFH. Generally, a consultation begins when NMFS receives the federal action agency's EFH Assessment. An EFH Assessment is a critical review of the proposed project and its potential impacts to EFH. As outlined in the regulation, EFH assessments must include 1) a description of the action, 2) an analysis of the potential adverse effects of the action on EFH and the managed species, 3) the federal agency's conclusions regarding the effects of the action on EFH, and 4) proposed mitigation, if applicable. If appropriate, the assessment should also include the results of an onsite inspection, the views of recognized experts on the habitat or species affects, a literature review, an analysis of alternatives to the proposed action, and any other relevant information. To help inform the EFH assessment process, project proponents can use the NOAA EFH Mapper to view spatial representations of EFH. The EFH Mapper can be accessed from *http://www.habitat.noaa.gov/protection/efh/efhmapper/.*

To comply with the MSFCMA, it is anticipated most EFH consultations will occur with the NMFS once projects are selected and when a sufficient level of detail and information are available to identify site-specific avoidance, minimization, or mitigation measures; determine effects; and develop EFH conservation recommendations. For each proposed project, EFH assessments will be submitted to NMFS with a request for consultation. Prior to initiation of consultation, EFH technical assistance can be requested from NMFS during the design, planning, and permitting stages. Refer to Appendix 6.A for best practices and to the NMFS Southeast Region EFH webpage for additional information (*http://sero.nmfs.noaa.gov/habitat_conservation/efh/index.html).*

Some projects that could be proposed as part of future restoration planning may have completed EFH consultation prior to being tiered from this Draft PDARP/PEIS. In these instances, the pre-existing consultation may suffice and will be reviewed by the proponent action agency and NMFS to determine if the consultation is still valid. Reinitiating EFH consultation will generally not be required for projects unless the proposed activities adversely affect EFH in a manner or extent not previously considered.

6.9.3 Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (MMPA) was enacted in response to increasing concerns among scientists and the public that significant declines in some species of marine mammals were caused by human activities. The MMPA established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part.

The Department of Commerce, through the NMFS, is charged with protecting whales, dolphins, porpoises, seals, and sea lions. Walrus, manatees, otters, and polar bears are protected by the Department of the Interior through the USFWS. The MMPA established a moratorium on the taking of marine mammals in U.S. waters. It defines "take" to mean "to hunt harass, capture, or kill" any marine mammal or attempt to do so. The MMPA further defines "harass" as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) or has the potential to disturb a marine mammal or marine mammals stock in the wild by causing disruption of natural behavioral patterns (Level B harassment).

The MMPA generally prohibits "take" of marine mammals in U.S. waters by any person and by U.S. citizens in international waters. NOAA Fisheries can authorize take for the following activities:

- Scientific research.
- Enhancing the survival or recovery of a marine mammal species or stock.
- Incidental take during commercial fishing operations.
- Incidental take during nonfishery commercial activities.

Some of the restoration actions described in this PDARP/PEIS may result in "take" of marine mammals (e.g., scientific research and monitoring) or incidental take (e.g., entrapment or noise harassment from pile driving). Incidental takes or harassment are considered to be unintentional, but not unexpected. NMFS issues two types of authorizations—one for incidental harassment, an incidental harassment authorization (IHA), and the other for ITA. See Table 6.9-1 below for more information.

Table 6.9-1. Decision tree for MMPA authorizations.

If your action has potential to	Then you should
Result in **"harassment"** only (i.e., injury or disturbance)	Apply for an Incidental Harassment Authorization (effective up to one year)
Result in harassment only (i.e., injury or disturbance) AND is planned for multiple years	Apply for a Letter of Authorization[b] (effective up to five years)
Result in **"serious injury"** or mortality	Apply for a Letter of Authorization[b] (effective up to five years)

[a] For activities that occur in Arctic waters where the activity has the potential to affect the availability of a species or stock of marine mammals for subsistence uses, your monitoring plan must be peer reviewed.

[b] For a Letter of Authorization (LOA), we must issue regulations. Regulations with an associated LOA may be issued for multiyear activities. These proposed actions must be well-planned with enough detailed information to allow for a robust analysis of the entire duration of your planned activity. Because an IHA can only be valid for one year and LOAs can be valid for up to five consecutive years, the rulemaking/LOA process is often used to reduce the administrative burden even when serious injury or mortality is not anticipated.

To facilitate compliance with the MMPA take provision, the Trustees will develop a systematic and efficient MMPA review with the NMFS and/or USFWS. The process will include initial screening of restoration projects by the appropriate agency to evaluate whether an activity is likely to result in an incidental take. This review process will evaluate whether 1) the activity does not have the potential to result in an incidental take (e.g., land acquisition) and therefore MMPA authorization is not warranted; 2) incidental take is unlikely to occur due to the nature of the activity, and/or the activity implements best practices to avoid, prevent, or mitigate take and therefore a MMPA authorization is not warranted; 3) incidental take is likely to occur, but if best practices are fully implemented to avoid, prevent, or significantly reduce the risk of take, an MMPA authorization may not be warranted; and 4) if incidental take is likely to occur, and it is not possible to prevent or mitigate risk, then the project proponent needs to apply to NMFS for an IHA or ITA, depending on the situation. Trustees will not authorize restoration projects that have not completed the MMPA review and/or received MMPA authorization, if required. For planning purposes, the timing generally required for authorizations under MMPA is provided on NMFS website.[11] For IHAs, applications should be made six to nine months in advance of the intended project start date. Some IHAs may take longer to process. For rulemakings/LOAs, applications should be made at least one year before project start date, preferably. There are two outcomes of the ITA process; see Table 6.9-2 for more information.

[11] *http://www.nmfs.noaa.gov/pr/permits/incidental/#when*; accessed August 9, 2015.

Table 6.9-2. Two outcomes of the ITA process.

	Letter of Authorization (LOA)	Incidental Harassment Authorization (IHA)
MMPA Section	101(a)(5)(A)	101(a)(5)(D)
May Authorize	Harassment or mortality	Harassment only (Level A or B)
Structure	• Requires promulgation of regulations • Cleared through NOAA/DOC/Office of Management and Budget • Regulations valid for five years. Once regulations are in place, LOA(s) may be issued • Process includes 2 comment periods for rulemaking (usually 30 and 60 days), but none for annual LOAs	• No rulemaking • Cleared in NMFS Office of Protected Resources • IHAs valid for up to one year • Process includes one 30-day comment period
Processing Time	Not prescribed by statute Typically: 12-18 months (caveats)	120 days by statute Typically: about 180 days

DOC = U.S. Department of Commerce.

Permits to conduct scientific research on marine mammals, or to enhance the survival or recovery of a species or stock, may be issued pursuant to Section 104 of the MMPA. These permits must specify the number and species of animals that can be taken and designate the manner (e.g., method, dates, and locations) in which the takes may occur. NMFS or USFWS must find that the manner of taking is "humane" as defined in the MMPA. The permit application must demonstrate that the taking will be consistent with the purposes of the MMPA and applicable regulations. NMFS has promulgated regulations to implement the permit provisions of the MMPA (50 CFR § 216) and provides application instructions, which prescribe the procedures (including the form and manner) necessary to apply for permits.

As future projects are considered for implementation, information will be shared from a project proponent to NOAA or USFWS through the use of a project form. This form provides an opportunity to include information about marine mammals that are covered under the ESA and MMPA and may be affected by a project. This early coordination will assist in ensuring the evaluations and actions proposed by the Trustees align with associated regulatory processes and considerations. For example, the issuance of an IHA, LOA, or scientific research permit (under MMPA) is a federal action subject to the requirements of NEPA, and it may be possible to include NMFS' or FWS's NEPA considerations into the Trustees' planning process described in Chapter 7, Governance. With the information provided in the form, implementing Trustees will coordinate early with regulatory agencies to better understand project-level risks and impacts to marine mammals and potentially identify best practices to reduce those risks.

6.9.4 Coastal Zone Management Act

The goal of the Coastal Zone Management Act (CZMA) is to encourage states to preserve, protect, develop, and, where possible, restore and enhance the resources of the nation's coastal zone. The CZMA encourages coastal states to develop and implement comprehensive management programs for activities that that balance the need for coastal resource protection with the need for economic growth and development in the coastal zone. Coastal management plans developed by a coastal state must be

approved by the Secretary of the U.S. Department of Commerce. Once a state's plan is approved, Section 307 of the CZMA, called the "federal consistency" provision, gives a state a strong role in federal agency decision-making for activities that may affect the coastal uses or resources of that state. The federal consistency provision is a major incentive for states to join the federal Coastal Zone Management Program and is a powerful tool that state programs use to manage coastal activities and resources and to facilitate cooperation and coordination with federal agencies.

Generally, "federal consistency" requires that federal actions, whether occurring within or outside the coastal zone of a state, *which will have reasonably foreseeable effects* on any coastal use (land or water) or natural resource within a state's coastal zone be consistent with the enforceable policies of the state's federally approved coastal management program. This requirement is addressed through processes that provide for state review of a federal agency's determination of consistency with the relevant state's federally approved program. The "federal consistency" requirement is applicable to a wide range of federal actions but does *not* apply to every action or authorization of a federal agency. It is triggered when it is reasonably foreseeable that a proposed federal agency activity or federal license or permit activity will have an ''effect on any coastal use or resource'' (referred to as the "effects test"). "Effects" in this context is not limited to environmental effects; it includes effects on coastal uses. It also includes both direct and indirect (cumulative and secondary) effects that would result from the activity, even if occurring later in time or farther away, as long as those effects are still reasonably foreseeable (15 CFR § 930.11-(g)).

Restoration actions proposed to be undertaken or authorized by federal agencies, including federal Trustees acting pursuant to OPA, are subject to review for "federal consistency" under the CZMA. Although the Draft PDARP/PEIS does not propose any specific restoration actions or projects, it does outline and describe a programmatic structure that would serve as the Trustees' overarching "blueprint" under which project-specific restoration plans would be developed, proposed, and selected, with substantial and meaningful opportunities for public participation in that process. It includes elements that would establish and guide the development of such plans. It also identifies the responsibilities and principles that the Trustees would apply and follow, individually and collectively, at every level of planning, to govern and provide for fulfillment of the Trustees' duty on behalf of the public to restore, replace, rehabilitate, and acquire natural resources or resource services as were lost, injured, or destroyed as a result of the *Deepwater Horizon* oil spill.

Although the PDARP/PEIS is programmatic in nature, the federal Trustees recognize that there are reasonably foreseeable effects on coastal uses and resources that would flow from adoption of the proposed Draft PDARP/PEIS. Further, federal and state agencies are encouraged to coordinate as early as possible in developing a proposed federal action under the CZMA regulations; guidance and procedures for federal and state agencies coordination, cooperation, and compliance with federally approved state coastal management plans under the CZMA are provided at 15 CFR § 930. Accordingly, the federal Trustees have evaluated those reasonably foreseeable effects of the PDARP/PEIS for consistency with the federally approved coastal management programs in Texas, Louisiana, Alabama, Mississippi, and Florida and are submitting these determinations for state review coincident with public review of this document.

6.9.5 National Historic Preservation Act

The National Historic Preservation Act of 1966 (NHPA), as amended in 2000 (NHPA; 16 USC § 470(w)), defines an historic property as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the National Register [of Historic Places]." Historic properties encompass built resources (e.g., bridges, buildings, and piers), landscapes, archeological sites, and traditional cultural properties (TCPs). TCPs are historic properties significant for their association with practices or beliefs of a living community that are both fundamental to that community's history and part of the community's cultural identity. These properties may be above ground, below grade, or submerged in waterways and include resources listed in, or eligible for listing in, the National Register of Historic Places (NRHP). Terrestrial cultural resources may include buildings, structures, sites, and objects. Cultural resources offshore may include shipwrecks, archeological sites, structures, or districts. Archaeological, architectural, and Native American resources are protected by a variety of laws and their implementing regulations.[12]

Although TCPs are typically associated with Native American culture, such historic properties also may be associated with other ethnic groups or communities. TCPs may vary between rural and urban areas and even within the same ethnic group. Research and contact with appropriate groups is part of the identification of TCPs.

The National Register of Historic Places (NRHP) is the official federal list of historic properties and is maintained by the National Park Service (NPS). As of November 2011, more than 10 percent of the properties listed in the NRHP were located in the affected Gulf states (9,083 of the 86,255 properties). The NRHP is dynamic; the list is not comprehensive and does not include all properties that meet the criteria for significance and integrity. Listings are limited only to those historic properties that have been formally documented, nominated, and accepted for inclusion by the Keeper of the NRHP.[13]

All projects tiered from this PDARP/PEIS will be reviewed under Section 106 of the NHPA prior to any project activities that would restrict consideration of measures to avoid, minimize, or mitigate any adverse impacts on historic properties located within a project area. Projects will be implemented in accordance with all applicable federal and state laws and regulations, including those laws and regulations concerning the protection of cultural and historic resources.

[12] Federally, these include the NHPA as amended in 2000; the Archeological and Historic Preservation Act of 1974; the Archaeological Resources Protection Act of 1979; the American Indian Religious Freedom Act of 1978; the Native American Graves Protection and Repatriation Act of 1990; the Submerged Lands Act of 1953; the Abandoned Shipwreck Act of 1987; and the Sunken Military Craft Act. The Advisory Council on Historic Preservation (ACHP) further guides treatment of archaeological and architectural resources through the Protection of Historic Properties (36 CFR § 800) regulations. Additional regulations and guidelines for shipwrecks include 10 USC 113, Title XIV for the Sunken Military Craft Act; and the Guidelines for Archaeological Research Permit Applications on Ship and Aircraft Wrecks under the Jurisdiction of the Department of the Navy.

[13] The NRHP includes historic properties that possess significance and integrity applying the National Register Criteria for Evaluation (36 CFR § 60(a-d)).

6.9.6 Coastal Barrier Resources Act

The Coastal Barrier Resources Act (CBRA) established the John H. Chafee Coastal Barrier Resources System, a defined set of geographic units along the Atlantic, Gulf of Mexico, Great Lakes, U.S. Virgin Islands, and Puerto Rico coasts. The CBRA restricts federal expenditures of funds for activities located within the Coastal Barrier Resources System unless those activities meet one of the listed exceptions under the CBRA. A federal agency proposing to spend funds within the Coastal Barrier Resources System must consult with the USFWS to determine whether the proposed federal expenditure meets one of the CBRA exceptions or is otherwise subject to restrictions. The USFWS will review future projects tiered from this PDARP/PEIS and subject to the CBRA and will engage in the intraservice consultation to confirm that exceptions to the CBRA's funding restrictions apply to those projects.

6.9.7 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA) implements various treaties and conventions among the United States, Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under MBTA, unless permitted by regulations, it is unlawful to pursue; hunt; take; capture or kill; attempt to take, capture, or kill; possess; offer to sell or sell; barter; purchase; deliver; or cause to be shipped, exported, imported, transported, carried, or received any migratory bird, part, nest, egg or product, manufactured or not. USFWS regulations broadly define "take" under MBTA to mean "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 CFR § 10.12).

Each future project tiered from this PDARP/PEIS will be reviewed by the USFWS to ensure "take," pursuant to the MBTA, does not occur. The review process will include the project sponsor documenting species or groups of birds likely to be present in the project area and likely behaviors the birds would be exhibiting on or near the project site (i.e., breeding, nesting, feeding, foraging, resting, or roosting). If migratory birds may be present in a project area, avoidance measures (included either in Appendix 6.A, Best Practices, and/or the project-specific sections of restoration plans tiered from this PDARP/PEIS) will be implemented to ensure these birds (including parts, nests, eggs, or products) are not wounded or killed during construction or use of the project area. Avoidance measures, where applicable, will be described within each specific project description. Projects that will need to be implemented throughout several seasons will utilize best practices to discourage migratory birds from using an area during construction. Best practices will be coordinated between the USFWS and the appropriate state Trustee agency. No future *Deepwater Horizon* PDARP/PEIS project will involve actions expected to hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell or barter, purchase, deliver or cause migratory birds to be shipped, exported, imported, transported, carried, or received.

6.9.8 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act of 1940 prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. The Bald and Golden Eagle Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb" (16 USC § 668(c)). For the purpose of this document, "disturb" means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific

information available, 1) injury to an eagle; 2) a decrease in its productivity by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior (50 CFR § 22.3). In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death, or nest abandonment.

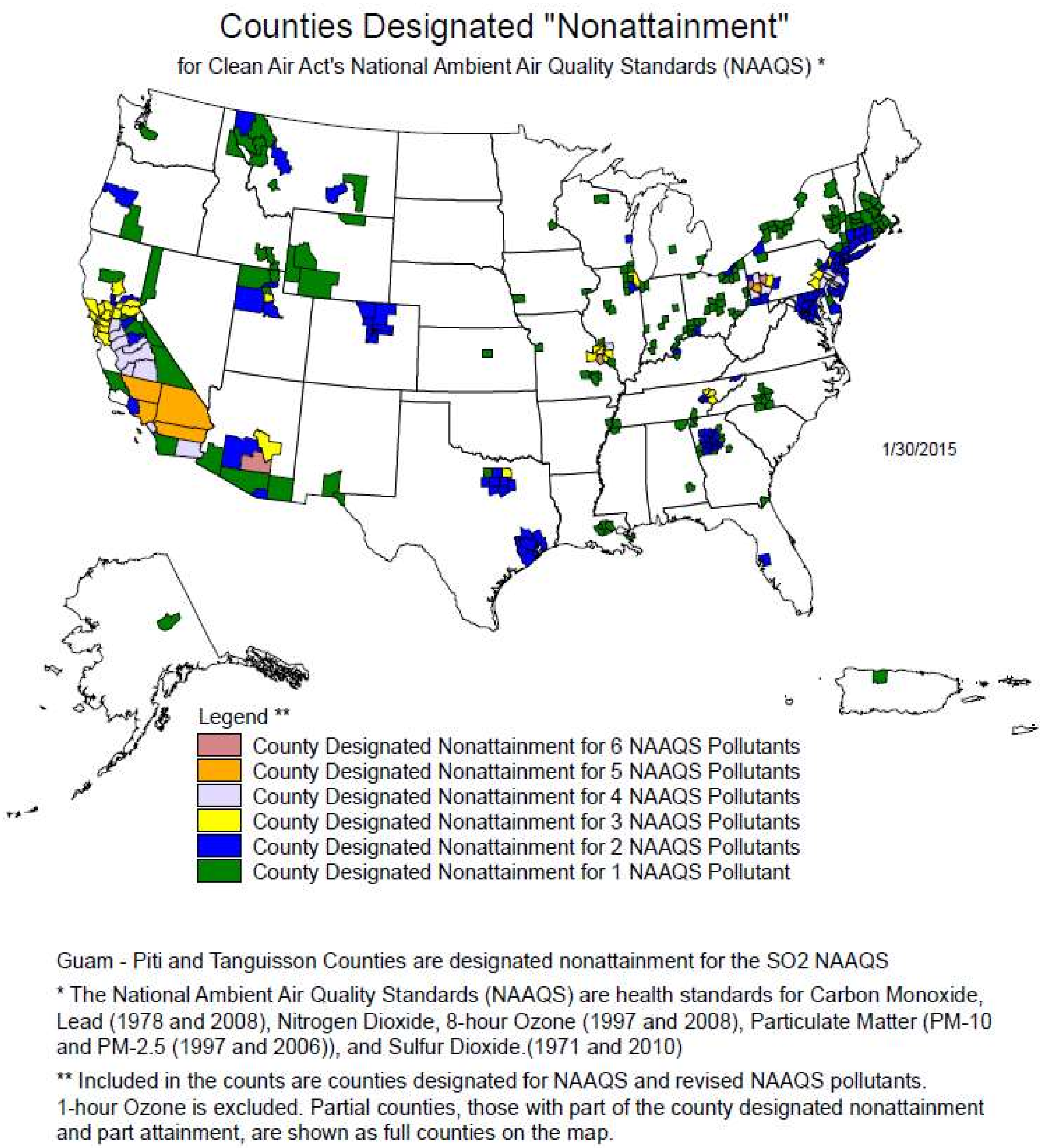
Eagles are not as sensitive to human disturbance during migration and wintering as they are while nesting. However, wintering eagles can congregate at specific sites year after year (i.e., established roost sites) for purposes of feeding and sheltering. Therefore, each future project tired from this PDARP/PEIS will be reviewed by USFWS to evaluate bald eagle status in the action area and determine if best practices (see Appendix 6.A) need to be put into place to avoid nonpurposeful "taking" or "disturbing" of bald eagles. Specifically, the review process will include the project sponsor documenting the presence or absence of known bald eagle nests or congregation/roosting sites. If nests or congregations are known, projects will be evaluated to determine if activities will be able to maintain a standard buffer distance (based on vegetation cover and nearby similar activities). If a standard buffer distance for project construction and the nest can be maintained, then the buffer distance will become a required best practice for project implementation. If a standard buffer distance cannot be maintained, then the sponsor will need to either alter the project or seek a nonpurposeful take permit. It is likely that any measures taken to protect bald eagles or other migratory birds will also protect golden eagles.

6.9.9 Clean Air Act

The Clean Air Act (CAA) requires EPA to set NAAQS for pollutants considered harmful to public health and the environment. NAAQS have been set for six common air pollutants (also known as criteria pollutants), consisting of particle pollution or particulate matter, ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead. Particulate matter is defined as fine particulates with a diameter of 10 micrometers or less (PM10), and fine particulates with a diameter of 2.5 micrometers or less (PM2.5). When a designated air quality area or airshed in a state exceeds one or more of the NAAQS, that area may be designated as a "nonattainment" area. Areas with levels of pollutants below the health-based standards are designated as "attainment" areas. To determine whether an area meets the NAAQS, air monitoring networks have been established and are used to measure ambient air quality.

There are only 28 counties/parishes in the Gulf Coast region that are classified as nonattainment areas (Figure 6.9-1, below). These counties surround the Houston, Texas, area, the New Orleans and Baton Rouge, Louisiana, areas, and the Tampa, Florida, area, and are listed below (Table 6.9-3). Environmental consequences of project actions in counties that are designated attainment areas (all other counties other than those listed in Table 6.9-3 would be expected to have similar air quality impacts, including GHG emissions, to those of Gulf of Mexico regionwide restoration projects (i.e., minor and short-term in duration and not resulting in exceedances of NAAQS or GHG emissions singularly or cumulatively) (DWH Trustees 2014, 2015; NOAA 2015). Projects located in or adjacent to counties designated as attainment areas would therefore be in compliance with CAA requirements and additional, project-specific analysis would not be required.

Projects located in or adjacent to counties designated as nonattainment areas, currently or in the future if other Gulf state counties receive the nonattainment designation, would be required to analyze project-specific air quality and GHG emissions. This analysis would be used to determine whether the project singularly or cumulatively, considering other foreseeable actions, would or would not likely result in exceedances of the identified NAAQS pollutant(s) and whether the project is consistent with a State Implementation Plan (SIP), if established.



Source: *EPA (2015).*

Figure 6.9-1. Counties designated “nonattainment.”

Table 6.9-3. List of counties by state-designated nonattainment.

Texas[a] (Houston area)	Chambers County Liberty County Montgomery County Harris County Waller County Fort Bend County Brazoria County Galveston County
Louisiana	St. Bernard Parish Livingston Parish East Baton Rouge Parish West Baton Rouge Parish Iberville Parish Ascension Parish
Florida	Hillsborough County

[a] Other counties classified as nonattainment areas in Texas are located in northern and western Texas EPA (2015).

6.9.10 Clean Water Act, Rivers and Harbors Act, and Marine Protection, Research and Sanctuaries Act

Waters of the United States, as defined by the Clean Water Act and implementing regulations, and navigable waterways, regulated by the Rivers and Harbors Act, are present throughout the Gulf Coast and could potentially be affected by proposed projects. Section 404 of the Clean Water Act requires USACE authorization prior to discharging dredged or fill material into waters of the United States, including wetlands and special aquatic sites. Section 10 of the Rivers and Harbors Act requires USACE authorization prior to any work in, under, or over navigable waters of the United States or which affects the course, location, condition, or capacity of such waters. Authorization from the USACE pursuant to Section 103 of the Marine Protection, Research and Sanctuaries Act may also be required for the transportation of dredged material for the purpose of dumping it in ocean waters.

There may be other provisions of the Clean Water Act or Rivers and Harbors Act that are also applicable to future *Deepwater Horizon* PDARP/PEIS projects depending on site-specific circumstances. Specifically with regard to the Rivers and Harbors Act, this includes Section 14, which applies to activities that could affect completed public works projects. Under Section 401 of the Clean Water Act, projects that entail discharge to wetlands or other waters within federal jurisdiction must obtain state certification of compliance with applicable state water quality standards. Under Section 401, states can review and approve, condition, or deny all federal permits or licenses that might result in a discharge to state waters, including wetlands. Section 402 of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permit program to regulate point source discharges of pollutants into waters of the United States. A NPDES permit sets specific limits for point sources discharging pollutants into waters of the United States and establishes monitoring and reporting requirements, as well as special conditions. EPA is charged with administering the permit program, but can authorize states to assume many of the permitting, administrative, and enforcement responsibilities. All five Gulf Coast states are authorized to issue NPDES permits.

For future *Deepwater Horizon* PDARP/PEIS projects with activities that might be subject to provisions included above, project sponsors would coordinate with the appropriate USACE District and/or state office responsible for authorizing such activities to help identify whether a permit is needed and, if so, what type. This early coordination helps facilitate information-sharing and communication, thus maximizing available efficiencies in the permitting process. Early coordination also allows for advance discussion of measures to avoid and minimize potential project impacts and helps inform sponsors on additional factors that are considered in the permit decision-making process.

6.9.11 Estuary Protection Act

The Estuary Protection Act encourages consideration in planning and development activities of the value of estuaries and the need to protect, conserve, and restore them. Where projects are proposed to take place within an estuary, the consideration of the potential impacts will include evaluation of the value of the estuarine resources.

6.9.12 Archaeological Resource Protection Act

The purpose of Archaeological Resource Protection Act (ARPA) is to secure, for the present and future benefit of the American people, the protection of archeological resources and sites that are on public and Indian lands. The Act fosters increased cooperation and exchange of information between governmental authorities, the professional archeological community, and private individuals having collections of archeological resources and data that were obtained before October 31, 1979. ARPA requires any person seeking to excavate or remove archaeological resources from public lands and Indian lands to obtain a permit from the appropriate federal land manager prior to conducting those activities. The Trustees will comply with ARPA's requirements for all *Deepwater Horizon* NRDA restoration projects that would occur on public lands and Indian lands.

6.9.13 National Marine Sanctuaries Act

The National Marine Sanctuaries Act is the principal statute governing the designation and management of protected marine areas of special significance. The statute requires NOAA to designate National Marine Sanctuaries in accordance with specific guidelines and to develop and review management plans for these sites. It provides for the continuation of existing leases, licenses, and other established rights in sanctuary areas and for the development of research and education programs. The statute also prohibits destruction, injury, or loss of sanctuary resources, and it establishes liability for response costs and natural resource damages for injury to these resources. If a site-specific restoration project has the potential to affect a marine sanctuary, the Trustees will develop appropriate avoidance or mitigation to comply with the National Marine Sanctuaries Act. Under Section 304(d) of the Act, federal agencies are required to consult for actions that may affect sanctuary resources. Through such consultations, the Secretary of Commerce may recommend mitigation to avoid adverse effects to resources. If such recommendations are made, the Trustees shall adopt the recommended mitigation. The Trustees will also coordinate with NOAA and provide the information necessary to complete the sanctuary development process if a proposed restoration project might result in new or expanded protection of marine areas of special significance.

6.9.14 Farmland Protection Policy Act

The Farmland Protection Policy Act was established to minimize the impact federal programs have on the conversion of farmland to nonagricultural uses. Farmland under the Act includes lands considered prime, unique, or of statewide or local importance. These lands are not limited solely to croplands, but also include forest land and pastureland. The Act requires federal programs to be compatible with state, local, and private programs and policies to protect farmland. Every two years, federal agencies must develop and review their programs and policies to implement the Act. The Act does not authorize the federal government to regulate the use of private or nonfederal land or affect the property rights of owners. Projects that may irreversibly convert farmland to nonagricultural use and are completed by a federal agency or with assistance from a federal agency are subject to the provisions of the Act. When specific restoration projects are proposed, the Trustees will determine the potential effects of the projects on farmland and coordinate with the NRCS when appropriate.

6.9.15 Additional Executive Orders

The following executive orders (EO) are also identified here. Compliance will follow in future tiered project-level actions under the *Deepwater Horizon* PDARP/PEIS.

6.9.15.1 EO 11988: Floodplain Management

EO 11988, Floodplain Management, requires federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of flood plains and avoid direct and indirect support of floodplain development wherever there is a practicable alternative.

6.9.15.2 EO 11990: Protection of Wetlands

EO 11990, Protection of Wetlands, is intended to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. To meet these objectives, the Order requires federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided.

6.9.15.3 EO 12898: Environmental Justice

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of programs, policies, and activities on minority or low income populations. Environmental justice review should be incorporated into the NEPA process and, where disproportionate adverse effects on minority and low-income populations are identified, address those impacts.

6.9.15.4 EO 12962: Recreational Fisheries

EO 12962, Recreational Fisheries, is intended to conserve, restore, and enhance aquatic systems to provide for increased recreational fishing opportunities nationwide.

6.9.15.5 EO 13112: Invasive Species

EO 13112, Invasive Species, applies to all federal agencies whose actions may affect the status of invasive species, requires agencies to identify such actions, and to the extent practicable and permitted by law, requires agencies to 1) take actions specified in the Order to address the problem consistent

with their authorities and budgetary resources and 2) not authorize, fund, or carry out actions that they believe are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless

> pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

6.9.15.6 EO 13175: Consultation and Coordination with Indian Tribal Governments

EO 13175, Consultation and Coordination with Indian Tribal Governments, reaffirms the federal government's commitment to a government-to-government relationship with Indian tribes and directs federal agencies to establish procedures to consult and collaborate with tribal governments when new agency regulations would have tribal implications.

6.9.15.7 EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds

EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, directs executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act.

6.9.15.8 EO 13693: Planning for Federal Sustainability in the Next Decade

EO 13693, Planning for Federal Sustainability in the Next Decade, directs federal leadership in energy, environmental, water, fleet, buildings, and acquisition management to continue to drive national GHG reductions and support preparations for the impacts of climate change.

6.9.16 Compliance with State and Local Laws and Other Federal Regulations

As future project-level analyses are tiered from this PDARP/PEIS, Trustees will ensure compliance with all applicable state and local laws and other applicable federal laws and regulations relevant to the individual state within which the project is to be located. Those laws and regulations relevant to individual proposed projects will be addressed in subsequent restoration planning.

6.10 Relationship Between Short-Term Use of the Human Environment and Long-Term Productivity

Section 102(2)(c)(iv) of NEPA requires that an EIS "discuss…the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity…." This section describes how the action alternatives would affect the short-term uses of the human environment and how that would affect the maintenance or enhancement of long-term productivity.

As described in Chapter 5, the purpose of this action is to restore extensive and complex injuries to natural resources and services resulting from the *Deepwater Horizon* spill. To meet this purpose, the Trustees have proposed alternatives intended to improve certain aspects of the human environment and thus maintain and enhance the long-term productivity of a number of natural resources. Sections 6.4, Evaluation of Environmental Consequences of Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative) and 6.4.15, Summary of Impacts of Alternative A, describe the kinds of short- and long-term adverse impacts and/or benefits that would be expected for the different restoration types.

For a number of restoration approaches, such as restoring wetlands, coastal, and nearshore habitats; federal lands; water quality; fish; sturgeon; sea turtles; SAV; marine mammals; birds; mesophotic and deep benthic habitats; oysters; as well as providing recreational opportunities, restoring barrier islands and beaches, and conserving habitats, short-term adverse impacts generally include those impacts associated with construction or implementation of restoration activities. However, not only would these impacts be expected to be temporary, but these restoration approaches are intended to enhance long-term productivity of natural resources. For example, restored habitats would provide food, shelter, breeding, and nursery habitat for many ecologically and economically important animals.

Some restoration approaches, particularly those focused on recreational use, intend to provide and enhance recreational opportunities that would increase access to, and the recreational use of, resources. Depending on how those uses are managed, these restoration approaches could result in both short-term and long-term impacts to habitats and resources. However, those impacts are not expected to degrade long-term productivity; overall, the alternatives considered here are expected to enhance long-term productivity.

6.11 Irreversible and Irretrievable Commitment of Resources

Section 102(2)(c)(v) of NEPA requires that an EIS "discuss…any irreversible and irretrievable commitment of resources which would be involved in the proposed action should it be implemented" (40 CFR § 1502.16). However, NEPA and the CEQ regulations do not define "irreversible and irretrievable." For purposes of this analysis, a commitment of a resource includes such things as agency funding or staff necessary to undertake a project.

Implementation of any of the action alternatives would require an irreversible and irretrievable commitment of resources, including staff time for project planning and development, and the associated funding necessary to go through the consultation, coordination, and decision-making processes. Other resource use that would be irreversible and irretrievable would be the use of energy through the combustion of fossil fuels and material resources for construction. However, the level of commitment would vary based on restoration approach. For example the reconstruction of a wetland would require more resources than those used by an action that replants vegetation on beaches.

6.12 Unavoidable Adverse Impacts

Section 102(2)(c)(ii) of NEPA requires that an EIS include information on "any adverse environmental effects which cannot be avoided should the proposed action be implemented." Unavoidable adverse impacts are the effects on human environment that would remain after mitigation measures and best practices have been applied. Unavoidable adverse impacts do not include temporary or permanent impacts that would be mitigated. While these impacts do not have to be avoided by the planning agency, they must be disclosed, considered, and mitigated where possible (40 CFR § 1500.2(e)). For some restoration approaches described above, mitigation measures and best practices are identified as options that can be used to avoid, reduce, minimize, or mitigate these impacts, where applicable, during implementation. These mitigation options are provided for consideration in future project development and selection. They vary based on site-specific conditions and are not required mitigations as part of the action alternatives. Therefore, subsequent restoration plans will consider appropriate mitigation measures and best practices. Unavoidable adverse impacts associated with conversion of habitat and built infrastructure are considered and evaluated for relevant restoration approaches where reasonably foreseeable. In addition, future *Deepwater Horizon* PDARP/PEIS planning phases and associated NEPA analyses would consider the extent to which adverse impacts can be avoided, including consideration of appropriate mitigation, and would describe those adverse impacts that are unavoidable. Many examples of best practices are identified in Appendix 6.A.

6.13 Consideration of Incomplete or Unavailable Information

Programmatic NEPA reviews may support policy- and planning-level decisions when there are limitations in available information regarding the timing, location, and environmental impacts of subsequent implementing action(s). For example, in the absence of certainty regarding the environmental consequences of future proposed actions, agencies may be able to make broad program decisions and establish parameters for subsequent analyses based on a programmatic review that adequately examines the reasonably foreseeable consequences of a proposed program, policy, plan, or suite of projects (CEQ 2014).

The broad scope of the restoration planning decisions made at this time makes it impossible to fully analyze the environmental impacts of potential projects that may be developed over the implementation period of this PDARP/PEIS. For example, not-yet-specified timing and project locations regarding future bird restoration projects causes NEPA analysis at this time to only consider a broad range of potential impacts that could result from implementation of restoration approaches, rather than a site-specific analysis. In other cases, restoration approaches may be more novel, where the environmental consequences of implementing specific projects under those approaches are incompletely known, such as coral transplantation for deep benthic coral communities. Accordingly, the Trustees will use the available information in this programmatic review to make reasoned, broad program decisions and establish parameters for the future restoration plans that will tier from this document. Further, monitoring and adaptive management will be key components in future restoration projects.

6.14 Consideration of the Effects of Climate Change

In 2014, the CEQ issued revised draft guidance on considering the effects GHG emissions and climate change in the analysis of proposed actions under NEPA (CEQ 2014). The draft climate change guidance also suggests ways that federal agencies should consider effects of climate change in developing projects that are resilient in nature and able to adapt to changes in the existing environmental conditions over time.

6.14.1 Impacts of Restoration Approaches on GHG Emissions

Increases in GHG increase the amount of heat trapped and increase global temperatures. (EPA 2015) reports that global warming over the past 50 years is due primarily to human-induced emissions of heat-trapping GHG, primarily from "burning fossil fuels (coal, oil, and gas), with important contributions from deforestation, agricultural practices, and other activities." GHGs (other than water vapor) comprise CO_2 (82 percent) and much smaller amounts of methane, nitrous oxide, and fluorinated gases (the remaining 18 percent) (EPA 2015). The construction industry alone produced approximately 1.7 percent of total U.S. GHG emissions in 2002, representing 6 percent of the total U.S. industrial-related GHG emissions (Lee et al. 2009). EPA estimates of CO_2 emissions into the atmosphere in 2011 from diesel-powered construction and mining equipment total 75 million tons. However, GHG emissions from construction equipment on project sites are highly variable, and standardized methods with adequate accuracy and reliability are needed (Lee et al. 2009).

Pursuant to CEQ issued draft guidance to federal agencies on evaluating GHG emissions and the impacts of climate change under NEPA, a NEPA analysis should consider both of the following:

- The potential effects of a proposed action on climate change (using projected GHG emissions as a proxy for those effects).
- The implications of climate change for the environmental effects of the proposed action (i.e., impacts with respect to how climate change may alter the effects and of the proposed action).

Major federal actions may have incremental, or project-by-project, climate change impacts "which have not been afforded the appropriate level of attention and analysis in prior NEPA reviews" (CEQ 2014). In considering GHG emissions under NEPA, CEQ guidance suggests that the extent of the analysis should be commensurate with the quantity of projected GHG emissions. This concentrates analyses on matters that are truly important to making a decision on the proposed action. When assessing the potential significance of the climate change impacts such as GHG emissions resulting from a proposed action, agencies should consider both context and intensity, as is done for all other impacts. Under the revised draft guidance, it is the emission of GHG that constitutes an environmental impact and not the effects of those emissions on climate dynamics. As subsequent restoration plans tier from this Draft PDARP/PEIS (see Section 6.17, NEPA Considerations and Tiering Future Restoration Planning), an appropriate level of analysis of GHG emissions will be included in the related NEPA analyses, and any project or site-specific considerations related to climate change would be updated.

(Mitsch et al. 2012), based on carbon flux analysis of 21 wetland studies, concluded that

> wetland ecosystems provide an optimum natural environment for the sequestration and long-term storage of CO2 from the atmosphere…and can be created and restored to provide carbon sequestration and other ecosystem services without great concern of creating net radiative sources on the climate due to methane emissions.

The authors found that while wetlands are also natural sources of GHG emissions, especially methane, methane emissions become unimportant within 300 years and most wetlands become both net carbon and radiative sinks within the same or smaller time frames.

Many of the restoration approaches in this Draft PDARP/PEIS could include some construction activities. For example, the restoration types Wetlands, Coastal, and Nearshore Habitats, Submerged Aquatic Vegetation, and Habitat Projects on Federally Managed Lands, are expected to involve construction activities. Emissions of GHGs into the atmosphere from the use of construction machinery would vary by individual project and would be addressed on a project-by-project basis. Restoration of these types of habitats, however, could, over time, result in carbon sequestration in excess of construction-related emissions and internal methane emissions, as described by Mitsch et al. (Mitsch et al. 2012).

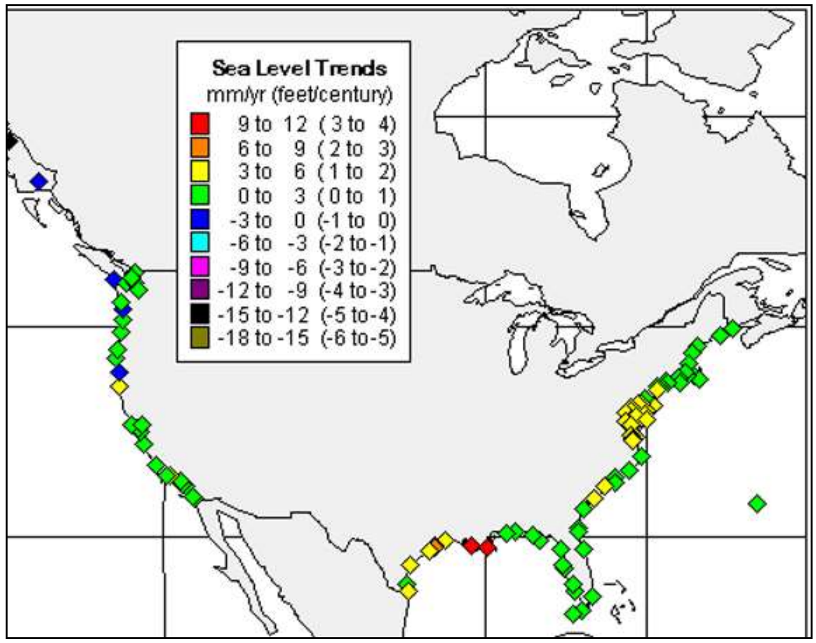
Other restoration approaches evaluated in this Draft PDARP/PEIS may result in incidental increased GHG emissions due to vehicle emissions for travel, additional monitoring efforts, and similar small-scale activities. For example, species-specific restoration types, such as restoration of fish and water column invertebrates, marine mammals, and birds and reducing sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures may result in GHG emissions from additional monitoring efforts, potential pilot projects, and similar small-scale activities.

6.14.2 Current Climate Change Projections

The Intergovernmental Panel on Climate Change (IPCC) projects a rise of the world's oceans from 0.26 to 0.82 meters by the end of the century, depending on the level of GHG emissions (IPCC 2013). In addition, the IPCC has concluded that "each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850" (IPCC 2013).

Climate change is projected to lead to a number of impacts in the southeastern United States, including increases in air and water temperatures, decreased water availability, an increase in the frequency of severe weather events, and ecosystem change. Average annual temperatures are predicted to increase 4 to 9 degrees Fahrenheit (USGCRP 2009). It is suggested that heavier rainfall is expected, separated by increased dry periods, which would result in increased risk of flooding and drought (USGCRP 2009).

Coastal environments are expected to be at increasing risk due to sea level rise and increases in hurricane intensity and storm surge. Figure 6.14-1 illustrates the projected changes in sea level. Areas experiencing little to no change in mean sea level are illustrated in green. Areas illustrated with positive sea level trends (yellow-to-red) are experiencing both global sea level rise and lowering or sinking of the local land, causing an apparently exaggerated rate of relative sea level rise. For example, some areas in Texas and Louisiana are experiencing subsiding land elevations, which are further exacerbating effects of sea level rise (NOAA 2013).



Source: *NOAA (2013).*

Figure 6.14-1. Regional mean sea level trends.

Climate change will likely have a number of impacts on the aquatic ecosystems of the northern Gulf of Mexico. Higher ocean temperatures are expected to increase coral bleaching (Scavia et al. 2002). Sea level rise and increasingly frequent coastal storms and hurricanes and associated storm surges will affect shorelines, altering coastal wetland hydrology, geomorphology, biotic structure, and nutrient cycling (Michener et al. 1997). Furthermore, an increase in atmospheric CO_2 concentrations is projected to increase freshwater discharge from the Mississippi River to the coastal ocean, decrease aquatic oxygen content, and expand the hypoxic zone in the northern Gulf of Mexico (Justic et al. 1997). Sea level rise could result in more frequent flooding of low-lying areas, which would permanently alter some ecological communities (USGCRP 2009).

In addition to effects to natural resources, climate change effects will likely cause damage to transportation infrastructure, affecting travel and damaging roads and bridges (USGCRP 2009). Hurricanes and storms will continue to damage property. Long-term development and projects will need to consider climate related effects in design stages to improve structure resiliency.

6.14.3 Climate Change Considerations in Planning

The CEQ (CEQ 2014), citing the National Research Council, provides the following general definition of climate change adaptation as:

> Action that can be implemented as a response to changes in the climate to harness and leverage its beneficial opportunities (e.g., expand polar shipping routes) or ameliorate its negative effects (e.g., protect installations from sea level rise).

The CEQ encourages pre-emptive planning to the extent practicable and consideration of climate change adaptations designed to reduce the vulnerability of a system to the effects of climate change. An example would be designing projects that are resilient across a range of future climate scenarios. In their recent draft guidance, the CEQ relies on 40 CFR § 1502.24 when it states that with regard to the effects of climate change on the design of a proposed action and alternatives, “an agency must present the environmental impacts of the proposed action in clear terms and with sufficient information to ensure the professional and scientific integrity of the discussion and analysis” (CEQ 2014).

A 2013 EO reinforces the direction to undergo planning efforts to develop projects that are more resilient to changes in the environment over time as a result of climate change effects. It states that

> The Federal Government must build on recent progress and pursue new strategies to improve the Nation's preparedness and resilience. In doing so, agencies should promote: (1) engaged and strong partnerships and information sharing at all levels of government; (2) risk-informed decision-making and the tools to facilitate it; (3) adaptive learning, in which experiences serve as opportunities to inform and adjust future actions; and (4) preparedness planning. (Executive Order, Preparing the United States for the Impacts of Climate Change, November 1, 2013)

Projects associated with the restoration types evaluated in this Draft PDARP/PEIS are not inconsistent with the EO and CEQ guidance on climate change.

Consideration of coastal vulnerability from climate change factors is important in planning. The IPCC defines vulnerability as “the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes” (IPCC 2007). Factors affecting coastal vulnerability include the physical characteristics of a particular setting and climate and nonclimate drivers (Burkett & Davidson 2012). Climate drivers include sea level change, waves and currents, winds, storminess, atmospheric CO_2, atmospheric temperature, water properties, sediment supply, and groundwater availability (Burkett & Davidson 2012). Figure 6.14-2 illustrates coastal vulnerability as a result of projected sea level rise for the northern Gulf Coast. Consideration of factors such as sea level rise,

Source: *USGS National Index of Coastal Vulnerability to Sea Level Rise, Data Basin 2014.*

Figure 6.14-2. Gulf Coast Vulnerability to Sea Level Rise Index.

Yellow areas have moderate vulnerability to seas level rise, orange areas have high vulnerability and red areas have very high vulnerability.

changes to shorelines, and altered hydrology at the project design stage has allowed, and will allow, for the anticipation of a range of environmental changes and the development of projects that would be more resilient over time based on current understanding of these factors. Changes in these factors however, may affect the longevity of some projects post-construction. As described in Chapter 5, Section 5.5, Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative), the preferred alternative includes a specific focus on achieving large-scale benefits to coastal habitats that are expected to contribute to the overall health and resiliency of northern Gulf of Mexico coastal environment and resources.

6.15 Best Practices

NOAA and USFWS have established best practices, which include guidance documents, lessons learned, and project design criteria for many restoration actions. Project proponents are expected to consider these, and any additional relevant best practices, in the development of subsequent restoration projects and associated regulatory compliance. Trustees will use appropriate best practices to avoid or minimize impacts to natural resources, including listed species and their habitats.

As part of future project-specific environmental review, appropriate best practices and mitigation measures would be selected prior to project implementation. For example, projects that require use of a borrow source for material to use in upland or submerged habitats (e.g., beach renourishment and wetland or marsh creation) would use appropriate sources that were chemically and physically suitable to the placement site. Another example would be avoiding or minimizing activities in sensitive habitats during critical periods, such as sea turtle nesting beaches during the nesting season.

Appendix 6.A, Best Practices, provides a list of measures that could be included, as appropriate, on a project-specific basis to avoid, minimize, or reduce potential adverse effects to the resources. Appendix 6.A is intended to evolve as an adaptive management component of implementing the PDARP/PEIS. As such, the appendix is intended be a living document. As new best practices are established, existing best practices are refined, or new techniques and information are informed by implementation, these measures will be added to or updated in the relevant websites identified in Appendix 6.A. In this capacity, new projects will have available the current range of best practices to support project design and implementation.

6.16 Environmental Justice Considerations in Future Restoration Planning

The intent of an environmental justice evaluation under EO 12898, Federal Actions to Address Environmental Justice in Minority and Low Income Populations (1994), 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 evaluate impacts on minority or low-income populations during preparation of environmental and socioeconomic analyses of projects or programs that are proposed, funded, or licensed by federal agencies.

According to CEQ and EPA guidelines established to assist federal and state agencies, a minority population is present in a project area if 1) the minority population of the affected area exceeds 50 percent or 2) the minority-population percentage of the affected area is meaningfully greater than the minority-population percentage in the general population or other appropriate unit of geographic analysis. By the same rule, a low-income population exists if the project area consists of 50 percent or more people living below the poverty threshold, as defined by the U.S. Census Bureau, or is meaningfully greater than the poverty percentage of the general population or other appropriate unit of geographic analysis.

The CEQ guidance indicates that when agencies determine whether environmental effects are disproportionately high and adverse, they are to consider whether there is or would be an impact on the natural or physical environment (as defined by NEPA) that would adversely affect a minority or low-income population.

None of the published guidelines defines the term “disproportionately high and adverse,” but CEQ includes a nonquantitative definition, stating that an effect is disproportionate if it appreciably exceeds the risk, or rate, to the general population (CEQ 1997b).

The restoration approaches that make up the programmatic alternative are not, in general, expected to create a disproportionately high and adverse effect on a minority or low-income populations. Population characteristics, including race and ethnicity and per-capita income as it relates to the poverty level, as well as effect determinations considered for environmental justice analyses will be considered in future projects tiered from this PDARP/PEIS. Project-specific data, such as that available from the EPA Environmental Justice mapping tool, “EJView”[14] will be utilized to consider implications for local minority or low-income populations.

[14] *http://epamap14.epa.gov/ejmap/entry.html*

6.17 NEPA Considerations and Tiering Future Restoration Planning

6.17.1 NEPA Considerations and Tiering Future Restoration Planning

> **Tiering**
>
> *Tiering* refers to the coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basinwide program statements or ultimately site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared.

As described in Section 5.10.4. Subsequent Restoration Planning, and Section 7.2, Management Structure, the Trustees, through each Trustee Implementation Group (TIG), intend to prepare subsequent restoration plans integrated with NEPA analyses tiered from this PEIS (40 CFR § 1508.28). These subsequent restoration plans will propose projects or phases of projects (e.g., preliminary planning) or, in some cases, particularly for ESA-listed species, may propose strategic or resource-level plans to guide decision-making.

The programmatic analysis included in the Draft PDARP/PEIS provides a comprehensive plan for restoration and streamlines TIG restoration planning by evaluating broad programmatic issues and impacts, thereby allowing the Trustees to tier future project-specific analyses from the programmatic analyses. Tiering future project-specific analyses would reduce or eliminate duplicative documentation by focusing future project analyses on project-specific issues and incorporating by reference the issues evaluated in the broad programmatic analyses. When the TIGs propose future restoration projects for consideration, they may prepare environmental assessments for the projects that tier from this PEIS if the conditions and environmental effects described in the PEIS are still valid or address any exceptions. If the impacts of a future restoration project are identified, analyzed in this PEIS, and found to be not a significant impact, an environmental assessment tiered from this PEIS would produce a finding of no significant impact, and no further NEPA analysis would be necessary. If the impacts of a project were found to be significant, those impacts would be evaluated in a tiered EIS. The public will have an opportunity to review and comment as future restoration plans are developed.

6.17.2 Draft Restoration Plans and Corresponding NEPA Analysis

The TIGs will integrate the appropriate level of NEPA analysis with the subsequent restoration plans at draft and final. The NEPA analyses will tier from this PEIS, as appropriate, and be prepared in accordance with NEPA and implementing regulations. The NEPA analysis will be consistent with this PEIS and the environmental consequences described broadly for the relevant restoration approaches. In addition to regulatory requirements, the analysis will do the following:

- **Identify the level of tiered NEPA review (e.g., tiered EA or tiered EIS).** Restoration plans that propose projects with potentially significant adverse impacts will require a tiered EIS, including formal public scoping. Some proposals for preliminary project planning (e.g., selection of a project phase for funding of engineering and design) are analyzed in the PEIS and may not require a project-specific analysis and would instead incorporate this PEIS by reference.

- **Identify cooperating agencies and determine other environmental compliance requirements.** The TIG agencies generally will be cooperating agencies for purposes of NEPA. Additional cooperating agencies should be invited when they have jurisdiction by law or an agency has special expertise with respect to any environmental issue. This early coordination with other agencies either through cooperating agency roles or technical assistance on other environmental projects can provide for more efficient planning and can be a means to reduce environmental impacts early in the planning process. Draft and final restoration plans will describe other environmental compliance requirements and the status toward receiving necessary approvals.
- **Describe the affected environment.** The Trustees will focus on site-specific issues not addressed in this PEIS.
- **Analyze the direct, indirect, and cumulative impacts of the proposed projects.** The Trustees will determine if the effects are consistent with the environmental consequences analyzed in this PEIS and clearly describe any differences. This analysis will focus on the site-specific issues and need not repeat broader environmental analyses considered in this PEIS.
- **Consider mitigating measures.** The Trustees will indicate how practices identified in the PEIS to reduce potential environmental impacts were considered in developing proposed projects or how these practices will be used to reduce potential adverse impacts of the projects.
- **Evaluate projects under OPA requirements.** The Trustees will indicate how the planning and implementation considerations described in Chapter 5, Section 5.5, Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative), and Appendix 5.D, Restoration Approaches and OPA Evaluation, were considered when developing projects.
- **Designate a lead federal agency.** One federal Trustee agency will serve as the lead federal agency for each restoration plan's NEPA compliance. All four federal Trustees would be adopting this PEIS, therefore any of the federal agencies can serve as the lead for tiered NEPA analyses. Other federal Trustee agencies would participate as co-leads or as cooperating agencies in the NEPA analysis.
- **Provide opportunity for public comment.** As described in Chapter 7, Governance, and required by OPA NRDA regulations, TIGs will provide an opportunity for public review and comment on each subsequent restoration plan and tiered NEPA analysis.
- **Prepare final restoration plans and corresponding NEPA analysis.** Following the consideration of public comments, the TIGs will revise restoration plans and NEPA analyses as appropriate and will release a final restoration plan with the integrated final NEPA analysis. Note that the appropriate NEPA finding or decision document must be completed before the TIG can make final decisions on approving the restoration projects in a plan for implementation. Compliance with other environmental laws (e.g., ESA), will be completed at the timing appropriate for each particular statute, regulatory, or other approval process.

6.18 *Deepwater Horizon* Draft PDARP/PEIS Repositories

STATE	LIBRARY	ADDRESS	CITY	ZIP
AL	Dauphin Island Sea Laboratory, Admin Building	101 Bienville Boulevard	Dauphin Island	36528
AL	Thomas B. Norton Public Library	221 West 19th Ave.	Gulf Shores	36542
AL	ADCNR-State Lands Division Coastal Section Office	31115 5 Rivers Blvd.	Spanish Fort	36527
AL	Weeks Bay National Estuarine Research Reserve (NERR)	11300 US Highway 98	Fairhope	36532
AL	Mobile Public Library, West Regional Library	5555 Grelot Rd.	Mobile	36606
FL	Franklin County Public Library	29 Island Dr.	East Point	32328
FL	Okaloosa County Library	185 Miracle Strip Pkwy, SE	Ft. Walton	32548
FL	Panama City Beach Public Library	125000 Hutchison Blvd	Panama City Beach	32407
FL	Escambia Southwest Branch Library	12248 Gulf Beach Hwy	Pensacola	32507
FL	Wakulla County Library	4330 Crawfordville Hwy	Crawfordville	32327
FL	Walton County Library, Coastal Branch	437 Greenway Trail	Santa Rosa Beach	32459
FL	Santa Rosa County Clerk of Court, County Courthouse	5841 Gulf Breeze Pkwy	Gulf Breeze	32561
LA	St. Tammany Parish Library	310 W. 21st Ave	Covington	70433
LA	Terrebonne Parish Library	151 Library Dr.	Houma	70360
LA	New Orleans Public Library, Louisiana Division	219 Loyola Ave	New Orleans	70112
LA	East Baton Rouge Parish Library	7711 Goodwood Blvd.	Baton Rouge	70806
LA	Jefferson Parish Library East Bank Regional Library	4747 W. Napoleon Ave.	Metairie	70001
LA	Jefferson Parish Library West Bank Regional Library	2751 Manhattan Blvd.	Harvey	70058
LA	Plaquemines Parish Library	8442 Hwy 23	Belle Chase	70037
LA	St. Bernard Parish Library	1125 E. St. Bernard Hwy	Chalmette	70043
LA	St. Martin Parish Library	201 Porter St.	Martinville	70582
LA	Alex P. Allain Library	206 Iberia St.	Franklin	70538
LA	Vermillion Parish Library	405 E. St. Victor St.	Abbeville	70510
LA	Martha Sowell Utley Memorial Library	314 St. Mary St.	Thibodaux	70301
LA	South Lafourche Public Library	16241 E. Main St.	Cut Off	70345
LA	Calcasieu Parish Public Library Central Branch	301 W. Claude St.	Lake Charles	70605
LA	Iberia Parish Library	445 E. Main St.	New Iberia	70560
LA	Mark Shirley, LSU Ag Center	1105 West Port St.	Abbeville	70510
MS	Biloxi Public Library, Local History and Genealogy Department	580 Howard Ave	Biloxi	39530
MS	West Biloxi Public Library	2047 Pass Rd.	Biloxi	39531

STATE	LIBRARY	ADDRESS	CITY	ZIP
MS	Waveland Public Library	333 Coleman Ave.	Waveland	39576
MS	Vancleave Public Library	12604 Hwy 57	Vancleave	39565
MS	Hancock County Library System	312 Hwy 90	Bay St Louis	39520
MS	Gulfport Harrison County Library	1708 25th Ave.	Gulfport	39501
MS	Pass Christian Public Library	111 Hiern Ave.	Pass Christian	39567
MS	Orange Grove Branch Library	12031 Mobile Ave.	Gulfport	39503
MS	Kathleen McIlwain Public Library	2100 Library Ln.	Gautier	39553
MS	Pascagoula Public Library	3214 Pascagoula St.	Pascagoula	39567
MS	Moss Point City Library	4119 Bellview	Moss Point	39563
MS	Ocean Springs Municipal Library	525 Dewey Ave.	Ocean Springs	39564
MS	Kiln Public Library	17065 Hwy 603	Kiln	39556
MS	Margaret Sherry Memorial Library	2141 Popps Ferry Rd.	Biloxi	39532
MS	East Central Public Library	21801 Slider Rd.	Moss Point	39532
MS	D'Iberville Library	10274 3rd Ave.	D'Iberville	39532
MS	Mercy Housing & Human Development	1135 Ford St.	Gulfport	39507
MS	Center for Environmental and Economic Justice	336 Rodenberg Ave.	Biloxi	39531
MS	MS Coalition for Vietnamese-American Fisher Folks and Families	1636 Popps Ferry Rd., Suite 228	Biloxi	39532
MS	STEPS Coalition	610 Water Street	Biloxi	39530
MS	Gulf Islands National Seashore Visitors Center	3500 Park Road,	Ocean Springs	39564
TX	Jack K. Williams Library, Texas A&M University at Galveston	Texas A&M University at Galveston; Building #3010, 200 Seawolf Pkwy	Galveston, TX 77554	77554
TX	Port Arthur Public Library	4615 9th Ave.	Port Arthur, TX 77672	77672
TX	Library Tex A&M Corpus Christi	6300 Ocean Drive	Corpus Christi, TX	78412

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[15] Additional representatives from Trustee agencies were substantively involved in review and comment on the Draft PDARP/PEIS and those inputs are reflected in the document.

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University of Louisiana, Lafayette	Mark Hester, Ph.D.	Interim Director, Institute for Coastal and Water Research and Professor of Biology	Ph.D., Louisiana State University MS, Louisiana State University BA, Indiana University
University of Maryland	Don Boesch, Ph.D.	Consultant	Ph.D., College of William and Mary, 1971 BS, Tulane University, 1967
University of Maryland	Kenneth McConnell, Ph.D.	Consultant	Ph.D., University of Maryland
University of South Alabama	Sean Powers, Ph.D.	Professor and Chair of Marine Sciences	Ph.D., Texas A&M University MS, University of New Orleans BS, Loyola University

6.20 References

Afonso, A., Santiago, R., Hazin, H., & Hazin, F. (2012). Shark bycatch andmortality and hook bite-offs in pelagic longlines: interactions between hook types and leader materials. *Fisheries Research, 131-133*, 9-14

Akin, S. & Winemiller, K.O. (2006). Seasonal variation in food web composition and structure in a temperate tidal estuary. *Estuaries and Coasts, 29*(4), 552-567. doi:10.1007/BF02784282

Alabama Oil and Gas Board (2011). (General) Retrieved from *http://www.gsa.state.al.us/ogb/ogb.html*

Apex Houston Trustee Council (Apex Houston Trustee Council). (2011). *Apex Houston Trustee Council Final Report*. Retrieved from *http://www.fws.gov/sfbayrefuges/murre/pdf/ApexHoustonFinalReport.pdf*.

Armentano, T.V. & Menges, E.S. (1986). Patterns of Change in the Carbon Balance of Organic Soil-Wetlands of the Temperate Zone. *Journal of Ecology, 74*(3), 755-774 Retrieved from <Go to ISI>://WOS:A1986D985700011

Arthur, C., Sutton-Grier, A.E., Murphy, P., & Bamford, H. (2014). Out of sight but not out of mind: Harmful effects of derelict traps in U.S. coastal waters. *Marine Pollution Bulletin, 86*(1-2), 19-28. doi:10.1016/j.marpolbul.2014.06.050

Barry, K.P., Condrey, R.E., Driggers, W.B., & Jones, C.M. (2008). Feeding ecology and growth of neonate and juvenile blacktip sharks Carcharhinus limbatus in the Timbalier–Terrebone Bay complex, LA, USA. *Journal of Fish Biology, 73*(3), 650-662. doi:10.1111/j.1095-8649.2008.01963.x

Beck, M.W., Kruczynski, W.L., & Sheridan, P.F. (2007). Conclusions: Importance of Gulf of Mexico seagrasses. In: L. Handley, D. Altsman, & R. DeMay (Eds.), *Seagrass status and trends in the northern Gulf of Mexico: 1940-2002: U.S. Geological Survey scientific investigations report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003.*(pp. 255-263).

Bejarano, A.C., Dunagan, H., & Michel, J. (2011). *Literature Review: Effects of Oil, Shoreline Treatment, and Physical Disturbance on Sand Beach Habitats*. (NS_TR.29). Seattle, WA. DWH Shoreline NRDA Technical Working Group Report.

Bilkovic, D.M., Havens, K.J., Stanhope, D.M., & Angstadt, K.T. (2014). Derelict fishing gear in Chesapeake Bay, Virginia: Spatial patterns and implications for marine fauna. *Marine Pollution Bulletin, 80*(1–2), 114-123. doi:*http://dx.doi.org/10.1016/j.marpolbul.2014.01.034*

BOEM (Bureau of Ocean Energy Management). (2011). *Guide to the OCS Alternative Energy and Alternate Use Programmatic EIS*. Outer Coast Information Center Retrieved from *http://www.boem.gov/Renewable-Energy-Program/Regulatory-Information/Guide-To-EIS.aspx*.

BOEM (Bureau of Ocean Energy Management). (2012). *Outer continental shelf oil and gas leasing program: 2012-2017. Final programmatic Environmental Impact Statement*. U.S. Department of Interior, Bureau of Ocean Energy Management. Retrieved from *http://www.boem.gov/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/Leasing/Five_Year_Program/2012-2017_Five_Year_Program/2012-2017_Final_PEIS.pdf*.

Boyer, M.E., Harris, J.O., & Turner, R.E. (1997). Constructed Crevasses and Land Gain in the Mississippi River Delta. *Restoration Ecology, 5*(1), 85-92

Browder, J.A., Saloman, C.H., Naughton, S.P., & Manooch III, C.S. (1983, November 4-5). Trophic relations of king mackerel in the coastal shelf ecosystem. Paper presented at the King Mackerel Symposium, Miami, FL.

Brumbaugh, R.D. & Coen, L.D. (2009). Contemporary Approaches for Small-Scale Oyster Reef Restoration to Address Substrate Versus Recruitment Limitation: A Review and Comments Relevant for the Olympia Oyster, Ostrea lurida Carpenter 1864. *Journal of Shellfish Research, 28*(1), 147-161. doi:10.2983/035.028.0105

Bulleri, F. & Chapman, M. (2010). The introduction of coastal infrastructure as a driver of change in marine environments. *Journal of Applied Ecology, 47*, 26-35

Burkett, V. & Davidson, M. (2012). *Coastal impacts, adaptation, and vulnerabilities: a technical input to the 2013 National Climate Assessment.* Washington, DC: Island Press.

Cahoon, D.R., White, D.A., & Lynch, J.C. (2011). Sediment infilling and wetland formation dynamics in an active crevasse splay of the Mississippi River delta. *Geomorphology, 131*(3-4), 57-68. doi:10.1016/j.geomorph.2010.12.002

Cake Jr., E.W. (1983). *Habitat suitability index models: Gulf of Mexico American oyster*. (82/10.57). U.S. Fish and Wildlife Service. Retrieved from *http://pubs.er.usgs.gov/publication/fwsobs82_10_57*.

Carle, M.V. & Sasser, C.E. (2015). Productivity and Resilience: Long-Term Trends and Storm-Driven Fluctuations in the Plant Community of the Accreting Wax Lake Delta. *Estuaries and Coasts*. doi:10.1007/s12237-015-0005-9

CCC (California Coastal Commission). (2011). The Problem With Marine Debris. Retrieved from *http://www.coastal.ca.gov/publiced/marinedebris.html*.

CEQ (Council on Environmental Quality). (1981). *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*. Retrieved from *http://energy.gov/sites/prod/files/G-CEQ-40Questions.pdf*.

Considering Cumulative Effects Under the National Environmental Policy Act (1997a).

CEQ (Council on Environmental Quality). (1997b). *Environmental Justice: Guidance under the National Environmental Policy Act*. Retrieved from *http://www.epa.gov/compliance/ej/resources/policy/ej_guidance_nepa_ceq1297.pdf*.

CEQ (Council on Environmental Quality). (2005). *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis*. Retrieved from *http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-PastActsCumulEffects.pdf*.

CEQ (Council on Environmental Quality). (2014). *79 FR 77801. Revised draft guidance for federal departments and agencies on consideration of greenhouse gas emissions and the effects of climate change in NEPA reviews*.

Chapman, D.J. & Julius, B.E. (2005). The use of preventative projects as compensatory restoration. *Journal of Coastal Research, Special Issue No. 40*(Winter), 120-131. doi:10.2307/25736620

Clark, R., Pittman, S.J., Battista, T.A., & Caldow, C. (2012). *Survey and impact assessment of derelict fishing traps in St. Thomas and St. John, U.S. Virgin Islands*. (NOAA Technical Memorandum NOS-NCCOS-147). Silver Spring, MD: National Oceanic and Atmospheric Administration. Retrieved from *http://ccma.nos.noaa.gov/ecosystems/coastalocean/2012_Marine_Debris_USVI_Final_Report.pdf*.

Coen, L.D. & Luckenbach, M.W. (2000). Developing success criteria and goals for evaluating oyster reef restoration: Ecological function or resource exploitation? *Ecological Engineering, 15*(3–4), 323-343. doi:*http://dx.doi.org/10.1016/S0925-8574(00)00084-7*

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S.J., Kubiszewski, I., Farber, S., & Turner, R.K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change, 26*, 152-158. doi:*http://dx.doi.org/10.1016/j.gloenvcha.2014.04.002*

Costanza, R., Pérez-Maqueo, O., Martinez, M.L., Sutton, P., Anderson, S.J., & Mulder, K. (2008). The Value of Coastal Wetlands for Hurricane Protection. *AMBIO: A Journal of the Human Environment, 37*(4), 241-248. doi:10.1579/0044-7447(2008)37[241:tvocwf]2.0.co;2

CPRA (Coastal Protection and Restoration Authority). (2012). *Louisiana's Comprehensive Master Plan for a Sustainable Coast*.

Crowder, L.B. & Murawski, S.A. (1998). Fisheries Bycatch: Implications for Management. *Fisheries, 23*(6), 8-17. doi:10.1577/1548-8446(1998)023<0008:FBIFM>2.0.CO;2

Day, J., Ko, J., Cable, J., Day, J., Fry, B., Hyfield, E., Justic, D., Kemp, P., Lane, R., & Mashriqui, H. (2003). Pulses: the importance of pulsed physical events for Louisiana floodplains and watershed management. Paper presented at the First Interagency Conference on Research in Watersheds.

Day, J., Lane, R., Moerschbaecher, M., DeLaune, R., Mendelssohn, I., Baustian, J., & Twilley, R. (2013). Vegetation and Soil Dynamics of a Louisiana Estuary Receiving Pulsed Mississippi River Water Following Hurricane Katrina. *Estuaries and Coasts, 36*(4), 665-682. doi:10.1007/s12237-012-9581-0

Day, J.W., Boesch, D.F., Clairain, E.J., Kemp, G.P., Laska, S.B., Mitsch, W.J., Orth, K., Mashriqui, H., Reed, D.J., & Shabman, L. (2007). Restoration of the Mississippi Delta: lessons from hurricanes Katrina and Rita. *Science, 315*(5819), 1679-1684

Deegan, L.A., Johnson, D.S., Warren, R.S., Peterson, B.J., Fleeger, J.W., Fagherazzi, S., & Wollheim, W.M. (2012). Coastal eutrophication as a driver of salt marsh loss. *Nature, 490*(7420), 388-+. doi:DOI 10.1038/nature11533

DeLaune, R.D., Jugsujinda, A., Peterson, G.W., & Patrick, W.H. (2003). Impact of Mississippi River freshwater reintroduction on enhancing marsh accretionary processes in a Louisiana estuary. *Estuarine Coastal and Shelf Science, 58*(3), 653-662. doi:10.1016/s0272-7714(03)00177-x

DeLaune, R.D., Jugsujinda, A., West, J.L., Johnson, C.B., & Kongchum, M. (2005). A screening of the capacity of Louisiana freshwater wetlands to process nitrate in diverted Mississippi River water. *Ecological Engineering, 25*(4), 315-321. doi:10.1016/j.ecoleng.2005.06.001

DeLaune, R.D., Kongchum, M., White, J.R., & Jugsujinda, A. (2013). Freshwater diversions as an ecosystem management tool for maintaining soil organic matter accretion in coastal marshes. *Catena, 107*, 139-144. doi:10.1016/j.catena.2013.02.012

Dugan, J.E., Hubbard, D.M., Engle, J.M., Martin, D.L., Richards, D.M., Davis, G.E., Lafferty, K.D., & Ambrose, R.F. (2000). Macrofauna communities of exposed sandy beaches on the southern California mainland and Channel Islands. Paper presented at the Fifth California Islands Symposium, Outer Continental Shelf Study, Camarillo, CA.

DWH Trustees (Deepwater Horizon Natural Resource Damage Assessment Trustees). (2014). *Final programmatic and Phase III early restoration plan and early restoration programmatic environmental impact statement*. Retrieved from *http://www.gulfspillrestoration.noaa.gov/restoration/early-restoration/phase-iii/*.

DWH Trustees (Deepwater Horizon Natural Resource Damage Assessment Trustees). (2015). *Deepwater Horizon oil spill draft Phase IV early restoration plan and environmental assessments*. Retrieved from *http://www.gulfspillrestoration.noaa.gov/restoration-planning/phase-iv/*.

Edgar, G.J., Banks, S.A., Bessudo, S., Cortés, J., Guzmán, H.M., Henderson, S., Martinez, C., Rivera, F., Soler, G., Ruiz, D., & Zapata, F.A. (2011). Variation in reef fish and invertebrate communities with level of protection from fishing across the Eastern Tropical Pacific seascape. *Global Ecology and Biogeography, 20*(5), 730-743. doi:10.1111/j.1466-8238.2010.00642.x

EPA (U.S. Environmental Protection Agency). (2003). *Protecting Water Quality from Urban Runoff*. Washington, DC: EPA Nonpoint Source Control Branch. Retrieved from *http://www.epa.gov/npdes/pubs/nps_urban-facts_final.pdf*.

EPA (U.S. Environmental Protection Agency). (2004). *Potential Risks of Nine Rodenticides to Birds and Nontarget Mammals: a Comparative Approach Office of Pesticides Programs*. Washington, DC: Environmental Fate and Effects Division.

EPA (U.S. Environmental Protection Agency). (2015). *Inventory of U.S. greenhouse gas emissions and sinks: 1990-2013*. Washington, DC.

Farrer, A.A. (2010). *N-Control. Seagrass restoration monitoring report. Monitoring events 2003-2008. Florida Keys National Marine Sanctuary, Monroe County, Florida*. (Marine Sanctuaries Conservation Series ONMS-10-06). Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries. Retrieved from *http://sanctuaries.noaa.gov/science/conservation/pdfs/ncontrol.pdf*.

Fertl, D. & Wursig, B. (1995). Coordinated feeding by Atlantic spotted dolphins (Stenella frontalis) in the Gulf of Mexico. *Aquatic Mammals, 21*(1), 3-5 Retrieved from *http://aquaticmammalsjournal.org/share/AquaticMammalsIssueArchives/1995/AquaticMammals_21-01/21-01_Fertl.pdf*

Fonseca, M.S. (1996). The role of seagrasses in nearshore sedimentary processes: A review. In: K.F. Nordstrum & C.T. Roman (Eds.), *Estuarine Shores; Evolution, Environments and Human Alterations.*(pp. 261-285). Chichester, England: John Wiley & Sons Ltd.

Fonseca, M.S. & Bell, S.S. (1998). The influence of physical setting on seagrass landscapes near Beaufort, North Carolina, USA. *Marine Ecology Progress Series, 171*, 109-121. doi:10.3354/meps171109

Fritelli, J. (2011). Can Marine Highways Deliver? Congressional Research Service 7-5700. Retrieved from Accessed at *http://enterrasolutions.com/media/docs/2012/02/R41590.pdf*.

FWS (U.S. Fish and Wildlife Service). (2012). *Comprehensive conservation strategy for the piping plover (Charadrius melodus) in its coastal migration and wintering range in the continental United States*. East Lansing, MI.

FWS & GSMFC (U.S. Fish and Wildlife Service & Gulf States Marine Fisheries Commission). (1995). *Gulf sturgeon (Acipenser oxyrinchus desotoi) recovery/management plan*. Atlanta, GA. Retrieved from *http://www.nmfs.noaa.gov/pr/pdfs/recovery/sturgeon_gulf.pdf*.

GCERC (Gulf Coast Ecosystem Restoration Council). (2013). *Draft Initial Comprehensive Plan: Restoring the Gulf Coast's Ecosystem and Economy*. Retrieved from *http://www.restorethegulf.gov/sites/default/files/Gulf%20Restoration%20Council%20Draft%20Initial%20Comprehensive%20Plan%205.23.15.pdf*.

GCERTF (Gulf Coast Ecosystem Restoration Task Force). (2011). *Gulf of Mexico Regional Ecosystem Restoration Strategy*. Retrieved from *http://www.gulfofmexicoalliance.org/pdfs/GulfCoastReport_Full_12-04_508-1_final.pdf*.

Geers, T.M. (2012). *Developing an ecosystem-based approach to management of the Gulf menhaden fishery: using Ecopath with Ecoism.*

Gilardi, K.V.K., Carlson-Bremer, D., June, J.A., Antonelis, K., Broadhurst, G., & Cowan, T. (2010). Marine species mortality in derelict fishing nets in Puget Sound, WA and the cost/benefits of derelict net removal. *Marine Pollution Bulletin, 60*(3), 376-382. doi:*http://dx.doi.org/10.1016/j.marpolbul.2009.10.016*

GMFMC (Gulf of Mexico Fishery Management Council). (2013). *Fishery Management Plans and Amendments*. Retrieved from *http://www.gulfcouncil.org/fishery_management_plans/index.php*.

GMFMC & NOAA (Gulf of Mexico Fishery Management Council

National Oceanic and Atmospheric Administration). (2007). *Final Amendment to the Reef Fish Fishery Management Plan and Amendment to the Shrimp Fishery Management Plan*.

Goodyear, C.P. (1967). Feeding Habits of Three Species of Gars, Lepisosteus, along the Mississippi Gulf Coast. *Transactions of the American Fisheries Society, 96*(3), 297-300. doi:10.1577/1548-8659(1967)96[297:FHOTSO]2.0.CO;2

Greene, K. (2002). *Beach Nourishment: A Review of the Biological and Physical Impacts*. Atlantic States Marine Fisheries Commission.

Guillory, V. (1993). Ghost fishing in blue crab traps. *North American Journal of Fisheries Management, 13*(3), 459-466. doi:10.1577/1548-8675(1993)013<0459:GFBBCT>2.3.CO;2

Gulf Coast Ecosystem Restoration Task Force (Gulf Coast Ecosystem Restoration Task Force). (2011). *Gulf of Mexico Regional Ecosystem Restoration Strategy*. Retrieved from *http://www.gulfofmexicoalliance.org/pdfs/GulfCoastReport_Full_12-04_508-1_final.pdf*.

Harborne, A.R., Mumby, P.J., Kappel, C.V., Dahlgren, C.P., Micheli, F., Holmes, K.E., Sanchirico, J.N., Broad, K., Elliott, I.A., & Brumbaugh, D.R. (2008). Reserve effects and natural variation in coral reef communities. *Journal of Applied Ecology, 45*(4), 1010-1018. doi:10.1111/j.1365-2664.2008.01490.x

Hart, D.D., Johnson, T.E., Bushaw-Newton, K.L., Horwitz, R.J., Bednarek, A.T., Charles, D.F., Kreeger, D.A., & Velinsky, D.J. (2002). Dam Removal: Challenges and Opportunities for Ecological Research and River Restoration. *BioScience, 52*(8)

Havens, K.J., Bilkovic, D.M., Stanhope, D.M., Angstadt, K.T., & Herschner, C. (2008). The Effects of Derelict Blue Crab Traps on Marine Organisms in the Lower York River, Virginia. *North American Journal of Fisheries Management, 28*(4), 1194-1200. doi:10.1577/M07-014.1

Hazel, J., Lawler, I.R., Marsh, H., & Robson, S. (2007). Vessel speed increases collision risk for the green turtle Chelonia mydas. *Endangered Species Research, 3*, 105-113

Heck Jr., K.L., Carruthers, T.J.B., Duarte, C.M., Hughes, A.R., Kendrick, G., Orth, R.J., & Williams, S.W. (2008). Trophic transfers from seagrass meadows subsidize diverse marine and terrestrial consumers. *Ecosystems, 11*(7), 1198-1210. doi:10.1007/s10021-008-9155-y

Heinz Center (2002). *Dam Removal Science and Decision Making. Heinz Center Panel on Economic, Environmental, and Social Outcomes of Dam Removal, Heinz Center for Science, Economics, and the Environment*. Washington, DC Retrieved from *http://water.epa.gov/polwaste/nps/upload/Dam_removal_full_report.pdf*.

Howes, N.C., FitzGerald, D.M., Hughes, Z.J., Georgiou, I.Y., Kulp, M.A., Miner, M.D., Smith, J.M., & Barras, J.A. (2010). Hurricane-induced failure of low salinity wetlands. *Proceedings of the National Academy of Sciences, 107*, 14014-14019. doi:10.1073/pnas.0914582107

IEA (International Energy Agency). (2014). *CO_2 Emissions from Fuel Combustion Highlights*. Retrieved from *http://www.iea.org/publications/freepublications/publication/co2-emissions-from-fuel-combustion-highlights-2014.html*.

IMDCC (Interagency Marine Debris Coordinating Committee). (2014). *The 2012-2013 progress report on the implementation on the Marine Debris Act*. National Oceanic and Atmospheric Administration. Retrieved from *http://marinedebris.noaa.gov/sites/default/files/imdccreport_2013_0.pdf*.

IPCC (Intergovernmental Panel on Climate Change). (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK.

IPCC (Intergovernmental Panel on Climate Change). (2013). *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. New York, NY.

Jeffrey, C.F.G., Leeworthy, V.R., Monaco, M.E., Piniak, G., & Fonseca, M. (2012). *An integrated biogeographic assessment of reef fish populations and fisheries in Dry Tortugas: Effects of No-take Reserves, NOAA Technical Memorandum NOS NCCOS 111*. Silver Spring, MD.

Jones, H.P. & Kress, S.W. (2012). A review of the world's active seabird restoration projects. *Journal of Wildlife Management, 76*(1), 2-9. doi:10.1002/jwmg.240

Justic, D., Rabalais, N.N., & Turner, R.E. (1997). Impacts of climate change on net productivity of coastal waters: implications for carbon budgets and hypoxia. *Climate Research, 8*(3), 225-237

Kearney, M.S., Riter, J.C.A., & Turner, R.E. (2011). Freshwater river diversions for marsh restoration in Louisiana: twenty-six years of changing vegetative cover and marsh area. *Geophysical Research Letters, 38*(16), n/a-n/a. doi:10.1029/2011gl047847

Kelleher, G. (1999). *Guidelines for Marine Protected Area*. Gland, Switzerland and Cambridge, UK: IUCN. Retrieved from *http://www.uicnmed.org/web2007/CDMURCIA/pdf/ingles/interestingdocuments/MPA_guidelines.pdf*.

Kemp, G.P., Day, J.W., & Freeman, A.M. (2014). Restoring the sustainability of the Mississippi River Delta. *Ecological Engineering, 65*, 131-146

Kim, W., Mohrig, D., Twilley, R., Paola, C., & Parker, G. (2009). Is it feasible to build new land in the Mississippi River Delta? *Eos, 90*(42), 373-384

King, K.A. (1989a). Food Habits and Organochlorine Contaminants in the Diet of Black Skimmers, Galveston Bay, Texas, USA. *Colonial Waterbirds, 12*(1), 109-112. doi:10.2307/1521319

King, K.A. (1989b). Food Habits and Organochlorine Contaminants in the Diet of Olivaceous Cormorants in Galveston Bay, Texas. *Southwestern Naturalist, 34*(3), 338-343. doi:10.2307/3672161

Kirkley, J.E. (2011). An Assessment of the Social and Economic Importance Of Menhaden (*Brevoortia tyrannus*) (Latrobe, 1802) in Chesapeake Bay Region 2011. *Annual Conference of the Southeast Association of Fish and Wildlife Agencies.*(Vol. 36). Gloucester Point, VA: VIMS Marine Resource Report No. 2011-14, Virginia Institute of Marine Science, College of William and Mary, School of Marine Science, Department of Fisheries.

Kramer, K.L. & Heck, K.L. (2007). Top-down trophic shifts in Florida Keys patch reef marine protected areas. *Marine Ecology Progress Series, 349*, 111-123

Kraus, S.D., Brown, M.W., Caswell, H., Clark, C.W., Fujiwara, M., Hamilton, P.K., Kenney, R.D., Knowlton, A.R., Landry, S., Mayo, C.A., McLellan, W.A., Moore, M.J., Nowacek, D.P., Pabst, D.A., Read, A.J., & Rolland, R.M. (2005). North Atlantic Right Whales in Chrisis. *Science, 309*, 561-562

Kress, S.W. (1983). The Use of Decoys, Sound Recordings, and Gull Control for Re-Establishing a Tern Colony in Maine. *Colonial Waterbirds, 6*, 185-196. doi:10.2307/1520987

LaBrecque, E., Curtice, C., Harrison, J., Van Parijs, S.M., & Halpin, P.N. (2015). 3. Biologically Important Areas for Cetaceans Within U.S. Waters – Gulf of Mexico Region. *Aquatic Mammals, 41*(1), 30-38. doi:10.1578/am.41.1.2015.30

LDNR (Louisiana Department of Natural Resources). (2015). Louisiana Energy Facts and Figures. (August 14). Retrieved from *http://dnr.louisiana.gov/index.cfm?md=navigation&tmp=iframe&pnid=0&nid=336*

Leatherwood, S. (1975). Some observations of feeding behavior of bottle-nosed dolphins (Tursiops truncatus) in the northern Gulf of Mexico and (Tursiops cf. T. gilli) off southern California, Baja California, and Nayarit, Mexico. *Marine Fisheries Review, 37*(9), 10-16 Retrieved from *http://spo.nmfs.noaa.gov/mfr379/mfr3792.pdf*

Lee, Y., Skibniewski, M., & Jang, W. (2009). Monitoring and management of greenhouse gas emissions from construction equipment using wireless sensors. Paper presented at the 26th International Symposium on Automation and Robotics in Construction (ISARC 2009).

Macfadyen, G., Huntington, T., & Cappell, R. (2009). *Abandoned, lost or otherwise discarded fishing gear.* (Fisheries and Aquaculture Technical Paper No. 523 ed.). Rome, Italy: Food and Agriculture Organization of the United Nations (FAO).

MARAD (U.S. Department of Transportation Maritime Administration). (n.d.). America's Marine Highway Program. (August 14, 2015). Retrieved from *http://www.marad.dot.gov/ships-and-shipping/dot-maritime-administration-americas-marine-highway-program/*

Matlock, G.C. & Garcia, M.A. (1983). Stomach contents of selected fishes from Texas bays. *Contributions in Marine Science, 26*, 95-110

Michel, J., Bejarano, A.C., Peterson, C.H., & Voss, C. (2013). *Review of Biological and Biophysical Impacts from Dredging and Handling Offshore Sand*. Herndon, VA.

Michener, W.K., Blood, E.R., Bildstein, K.L., Brinson, M.M., & Gardner, L.R. (1997). Climate change, hurricanes and tropical storms, and rising sea level in coastal wetlands. *Ecological Applications, 7*(3), 770-801. doi:10.1890/1051-0761(1997)007[0770:CCHATS]2.0.CO;2

Miller, C.E. (2003). *Abundance trends and environmental habitat usage patterns of bottlenose dolphins (Tursiops truncatus) in lower Barataria and Caminada bays, Louisiana.* (Ph.D.), Louisiana State University, Baton Rouge, LA.

Miller, C.E. & Baltz, D.M. (2009). Environmental characterization of seasonal trends and foraging habitat of bottlenose dolphins (*Tursiops truncatus*) in northern Gulf of Mexico bays. *Fisheries Bulletin, 108*(1), 79-86

Mitsch, W.J., Bernal, B., Nhlik, A., Mander, U., Zhang, L., Anderson, C., Jorgensen, S., & Brix, H. (2012). Wetlands, Carbon, and Climate Change. *Landscape Ecology, 28*(4), 583-597

MMS (Mineral Management Service). (2004). *Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf. Final Programmatic Environmental Assessment*. Retrieved from *http://www.boem.gov/Environmental-Stewardship/Environmental-Assessment/NEPA/nepaprocess.aspx*.

Moody, R.M. & Aronson, R.B. (2007). Trophic heterogeneity in salt marshes of the northern Gulf of Mexico. *Marine Ecology Progress Series, 331*, 49-65 Retrieved from <Go to ISI>://WOS:000244872400005

Moran, D. (1988). *Species profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico), Red Snapper*. Slidell, LA: U.S. Fish and Wildlife Service. Retrieved from *http://www.nwrc.usgs.gov/wdb/pub/species_profiles/82_11-083.pdf*.

Morris, J.T., Shaffer, G.P., & Nyman, J.A. (2013). Brinson Review: Perspectives on the Influence of Nutrients on the Sustainability of Coastal Wetlands. *Wetlands, 33*(6), 975-988 Retrieved from <Go to ISI>://WOS:000327386800001

NAS (National Academy of Science). (2009). *Tackling marine debris in the 21st century*. (978-0-309-12697-7). Washington, DC: Ocean Studies Board, Division of Earth and Life Sciences, National Research Council. Retrieved from *http://www.nap.edu/catalog/12486/tackling-marine-debris-in-the-21st-century*.

NFWF (National Fish and Wildlife Foundation). (n.d.). Gulf Environmental Benefit Fund. (General) (August 14, 2015). Retrieved from *http://www.nfwf.org/gulf/Pages/home.aspx*

NMFS (National Marine Fisheries Service). (2015). *Forecast for the 2015 Gulf and Atlantic menhaden purse-seine fisheries and review of the 2014 fishing season*. Beaufort, NC: National Oceanic and Atmospheric Administration. Retrieved from *https://www.st.nmfs.noaa.gov/Assets/commercial/market-news/Forecast%202015_Final.pdf*.

NMFS & FWS (National Marine Fisheries Service & U.S. Fish and Wildlife Service). (2008). *Recovery plan for the northwest Atlantic population of the Loggerhead sea turtle (Caretta caretta), second revision*. Silver Spring, MD. National Marine Fisheries, Service, U.S. Fish and Wildlife Service. Retrieved from *http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_loggerhead_atlantic.pdf*.

NMFS, FWS, & SEMARNAT (National Marine Fisheries Service, U.S. Fish and Wildlife Service, Secretaría del Medio Ambiente y Recursos Naturales). (2011). *Bi-national recovery plan for the Kemp's Ridley sea turtle (Lepidochelys kempii), second revision*. Silver Spring, MD: National Marine Fisheries Service.

NOAA (National Oceanic and Atmospheric Administration). (2006). *Supplemental Programmatic Environmental Assessment of NOAA Fisheries' Implementation Plan for the Community-based Restoration Program*.

NOAA (National Oceanic and Atmospheric Administration). (2011a). *The Gulf of Mexico at a glance: A second glance*. National Oceanic and Atmospheric Administration. Retrieved from *http://stateofthecoast.noaa.gov/NOAAs_Gulf_of_Mexico_at_a_Glance_report.pdf*.

NOAA (National Oceanic and Atmospheric Administration). (2011b). Office of Response and Restoration. Marine Debris Information. Impacts. (Lost Recreational Use) (August 14, 2015). Retrieved from *http://marinedebris.noaa.gov/*

NOAA (National Oceanic and Atmospheric Administration). (2012). *Measures for Reducing Entrapment Risk to Protected Species*.

NOAA (National Oceanic and Atmospheric Administration). (2013). *Regional mean sea level trends*. Retrieved from *http://tidesandcurrents.noaa.gov/sltrends/slrmap.htm*.

NOAA (National Oceanic and Atmospheric Administration). (2015). *Final Supplement to the Final Programmatic Environmental Impact Statement for the Fishery Management Plan for Regulating Offshore Marine Aquaculture in the Gulf of Mexico*.

NPS (National Park Service). (2014). *Natural Resource Condition Assessment for Jean Lafitte National Historical Park and Preserve*. Fort Collins, CO: Natural Resource Stewardship and Science Directorate.

Nyman, J.A., Baltz, D.M., Kaller, M.D., Leberg, P.L., Richards, C.P., Romaire, R.P., & Soniat, T.M. (2013). Likely Changes in Habitat Quality for Fish and Wildlife in Coastal Louisiana during the Next Fifty Years. *Journal of Coastal Research*, 60-74. doi:10.2112/SI_67_5

Oigman-Pszczol, S.S. & Creed, J.C. (2007). Quantification and Classification of Marine Litter on Beaches along Armação dos Búzios, Rio de Janeiro, Brazil. *Journal of Coastal Research*, 421-428. doi:10.2112/1551-5036(2007)23[421:QACOML]2.0.CO;2

Orth, R.J., Carruthers, T.J.B., Dennison, W.C., Duarte, C.M., Fourqurean, J.W., Heck, K.L., Hughes, A.R., Kendrick, G.A., Kenworthy, W.J., Olyarnik, S., Short, F.T., Waycott, M., & Williams, S.L. (2006). A global crisis for seagrass ecosystems. *BioScience, 56*(12), 987-996. doi:10.1641/0006-3568(2006)56[987:agcfse]2.0.co;2

Paling, E.I., Fonseca, M.S., van Katwijk, M.M., & van Kulen, M. (2009). In: G.M.E. Perillo, E. Wolanski, D.R. Cahoon, & M.M. Brinson (Eds.), *Coastal Wetlands: An Integrated Ecosystem Approach.*(pp. 685-713): Elsevier.

Panama City Port Authority (2015). Port Overview. Retrieved from *http://www.portpanamacityusa.com/port-overview.php*

Paola, C., Twilley, R.R., Edmonds, D.A., Kim, W., Mohrig, D., Parker, G., Viparelli, E., & Voller, V.R. (2011). Natural processes in delta restoration: application to the Mississippi Delta. *Ann Rev Mar Sci, 3*, 67-91. doi:10.1146/annurev-marine-120709-142856

Parker, M.W., Kress, S.W., Golightly, R.T., Carter, H.R., Parsons, E.B., Schubel, S.E., Boyce, J.A., McChesney, G.J., & Wisely, S.M. (2007). Assessment of Social Attraction Techniques Used to Restore a Common Murre Colony in Central California. *Waterbirds, 30*(1), 17-28. doi:10.1675/1524-4695(2007)030[0017:AOSATU]2.0.CO;2

Peterson, C.H., Bishop, M.J., Johnson, G.A., D'Anna, L.M., & Manning, L.M. (2006). Exploiting beach filling as an unaffordable experiment: Benthic intertidal impacts propagating upwards to shorebirds. *Journal of Experimental Marine Biology and Ecology, 338*(2), 205-221. doi:*http://dx.doi.org/10.1016/j.jembe.2006.06.021*

Petes, L.E., Brown, A.J., & Knight, C.R. (2012). Impacts of Upstream Drought and Water Withdrawals on the Health and Survival of Downstream Estuarine Oyster Populations. *Ecology and Evolution*, 1-13

Poff, N.L. & Hart, D.D. (2002). How dams vary and why it matters for the emerging science of dam removal. *BioScience, 52*(8), 661-668

Powell, E.N. & Klinck, J.M. (2007). Is Oyster Shell a Sustainable Estuarine Resource? *Journal of Shellfish Research, 26*(1), 181-194

Powell, G.V.N., Kenworthy, J.W., & Fourqurean, J.W. (1989). Experimental evidence for nutrient limitation of seagrass growth in a tropical estuary with restricted circulation. *Bulletin of Marine Science, 44*(1), 324-340

Powers, S.P., Peterson, C.H., Grabowski, J.H., & Lenihan, H.S. (2009). Success of constructed oyster reefs in no-harvest sanctuaries: implications for restoration. *Marine Ecology Progress Series, 389*, 159-170

Roberts, H.H. (1997). Dynamic changes of the Holocene Mississippi River delta plain: the delta cycle. *Journal of Coastal Research, 13*(3), 605-627 Retrieved from <Go to ISI>://WOS:A1997XQ32600004

Rose, K.A., Adamack, A.T., Murphy, C.A., Sable, S.E., Kolesar, S.E., Craig, J.K., Breitburg, D.L., Thomas, P., Brouwer, M.H., Cerco, C.F., & Diamond, S. (2009). Does hypoxia have population-level effects on coastal fish? Musings from the virtual world. *Journal of Experimental Marine Biology and Ecology, 381, Supplement*, S188-S203. doi:*http://dx.doi.org/10.1016/j.jembe.2009.07.022*

Rosen, T. & Xu, Y.J. (2013). Recent decadal growth of the Atchafalaya River Delta complex: effects of variable riverine sediment input and vegetation succession. *Geomorphology, 194*, 108-120. doi:10.1016/j.geomorph.2013.04.020

Rozas, L.P. & Minello, T.J. (2011). Variation in penaeid shrimp growth rates along an estuarine salinity gradient: implications for managing river diversions. *Journal of Experimental Marine Biology and Ecology, 397*(2), 196-207. doi:10.1016/j.jembe.2010.12.003

Rozas, L.P., Minello, T.J., Munuera-Fernández, I., Fry, B., & Wissel, B. (2005). Macrofaunal distributions and habitat change following winter–spring releases of freshwater into the Breton Sound estuary, Louisiana (USA). *Estuarine, Coastal and Shelf Science, 65*(1-2), 319-336. doi:10.1016/j.ecss.2005.05.019

Sauls, B., Alaya, O., & Cody, R. (2014). *A Directed Study of the Recreational Red Snapper Fisheries in the Gulf of Mexico along the West Florida Shelf 2009-2013*. (F2794-09-13-F). St. Petersburg, FL: Florida Fish and Wildlife Conservation Commission-Fish and WIldlife Research Institute.

Scavia, D., Field, J.C., Boesch, D.F., Buddemeier, R.W., Burkett, V., Cayan, D.R., Fogarty, M., Harwell, M.A., Howarth, R.W., Mason, C., Reed, D.J., Royer, T.C., Sallenger, A.H., & Titus, J.G. (2002). Climate change impacts on U.S. Coastal and Marine Ecosystems. *Estuaries, 25*(2), 149-164. doi:10.1007/BF02691304

Scollan, D. & Parauka, F. (2008). *Documentation of Gulf sturgeon spawning in the Apalachicola River, Florida, Spring 2008*. Panama City, FL: U.S. Fish and Wildlife Service. Retrieved from *http://www.fws.gov/panamacity/resources/Documentation%20of%20Gulf%20sturgeon%20spawning%20in%20the%20Apalachicola%20River_Final.pdf*.

Scott-Denton, E., Cryer, P.F., Duffy, M.R., Gocke, J.P., Harrelson, M.R., Kinsella, D.L., Nance, J.M., Pulver, J.R., Smith, R.C., & Williams, J.A. (2012). Characterization of the U.S. Gulf of Mexico and South Atlantic penaeid and rock shrimp fisheries based on observer data. *Marine Fisheries Review, 74*(1-26)

Selig, E.R. & Bruno, J.F. (2010). A global analysis of the effectiveness of marine protected areas in preventing coral loss. *PLoS One, 5*(2). doi:10.1371/journal.pone.0009278

Serafy, J.E., Cooke, S.J., Diaz, G.A., Graves, J.E., Hall, M., Shivji, M., & Swimmer, Y. (2012-a). Circle Hooks in Commercial, Recreational, and Artisanal Fisheries: Research Status and Needs for Improved Conservation and Management. *Bulletin of Marine Science, 88*(3), 371-391. doi:10.5343/bms.2012.1038

Serafy, J.E., Orbesen, E.S., Snodgrass, D.J.G., Beerkircher, L.R., & Walter, J.F. (2012-b). Hooking Survival of Fishes Captured by the United States Atlantic Pelagic Longline Fishery: Impact of the 2004 Circle Hook Rule. *Bulletin of Marine Science, 88*(3), 605-621. doi:10.5343/bms.2011.1080

Soniat, T.M., Conzelmann, C.P., Byrd, J.D., Roszell, D.P., Bridevaux, J.L., Suir, K.J., & Colley, S.B. (2013). Predicting the effects of proposed Mississippi River diversions on oyster habitat quality: Application of an oyster habitat suitability index model. *Journal of Shellfish Research, 32*(3), 629-638. doi:10.2983/035.032.0302

Soniat, T.M., Klinck, J.M., Powell, E.N., & Hofmann, E.E. (2012). Understanding the Success and Failure of Oyster Populations Periodicities of Perkinsus marinus, and Oyster Recruitment, Mortality, and Size. *Journal of Shellfish Research, 31*(3), 635-646

Suman, D., Shivlani, M., & Walter Milon, J. (1999). Perceptions and attitudes regarding marine reserves: a comparison of stakeholder groups in the Florida Keys National Marine Sanctuary. *Ocean and Coastal Management, 42*(12), 1019-1040. doi:*http://dx.doi.org/10.1016/S0964-5691(99)00062-9*

Swarzenski, C.M., Doyle, T.W., Fry, B., & Hargis, T.G. (2008). Biogeochemical response of organic-rich freshwater marshes in the Louisiana delta plain to chronic river water influx. *Biogeochemistry, 90*(1), 49-63. doi:DOI 10.1007/s10533-008-9230-7

Teal, J.M., Best, R., Caffrey, J., Hopkinson, C.S., McKee, K.L., Morris, J.T., Newman, S., & Orem, B. (2012). *Mississippi River freshwater diversions in southern Louisiana: effects on wetland vegetation, soils, and elevation*. National Oceanic and Atmospheric Administration.

Thomson, G., Miner, M., Wycklendt, A., Rees, M., & Swigler, D. (2010). *MRGO Ecosystem restoration feasibility study – Chandeleur and Breton Islands. Report prepared for USACE under contract to URS, Coastal Planning & Engineering, Inc.* Boca Raton, FL.

Treat, S.F. & Lewis III, R.R. (Eds. 2006). *Seagrass restoration: Success, failure, and the costs of both. Selected papers presented at a workshop, Mote Marine Laboratory, Sarasota, FL, March 11–12, 2003.* Valrico, FL: Lewis Environmental Services.

Turner, R.E. (2011). Beneath the salt marsh canopy: loss of soil strength with increasing nutrient loads. *Estuaries and Coasts, 34*(5), 1084-1093. doi:DOI 10.1007/s12237-010-9341-y

Uhrin, A.V., Matthews, T.R., & Lewis, C. (2014). Lobster Trap Debris in the Florida Keys National Marine Sanctuary: Distribution, Abundance, Density, and Patterns of Accumulation. *Marine and Coastal Fisheries, 6*(1), 20-32. doi:10.1080/19425120.2013.852638

USACE (U.S. Army Corps of Engineers). (2009). *Mississippi Coastal Improvements Program (MSCIP), Hancock, Harrison, and Jackson counties, Mississippi: Comprehensive Plan and Integrated*

Programmatic Environmental Impact Statement. Retrieved from *http://www.usace.army.mil/Portals/2/docs/civilworks/CWRB/mscip/mscip_slides.pdf*.

USACE (2015). Ocean Disposal Database. Retrieved from Ocean Disposal Database *http://el.erdc.usace.army.mil/odd/index.cfm*

USCG (U.S. Coast Guard). (2015). International Agreements. (General) (August 25). Retrieved from *http://www.pancanal.com/eng/pr/press-releases/.http://www.pancanal.com/eng/acp/acuerdos/*

USCOP (U.S. Commission on Ocean Policy). (2004). *An Ocean Blueprint for the 21st Century. Final Report*. Washington, DC.

USDA & NASS (U.S. Department of Agriculture, National Agricultural Statistics Service). (2005). *Census of Aquaculture (2005): Volume 3 Special Studies Part 2, AC-02-SP-2. 2002 Census of Agriculture*. Retrieved from *http://www.agcensus.usda.gov/Publications/2002/Aquaculture/AQUACEN.pdf*.

USGCRP (U.S. Global Change Research Program). (2009). *Climate change impacts in the United States.* New York, NY: Cambridge University Press.

Van, A., Rochman, C.M., Flores, E.M., Hill, K.L., Vargas, E., Vargas, S.A., & Hoh, E. (2012). Persistent organic pollutants in plastic marine debris found on beaches in San Diego, California. *Chemosphere, 86*, 258-263

VanderKooy, S. (2012). *The oyster fishery of the Gulf of Mexico, United States: A regional management plan - 2012 revision. Publication No. 202*. Ocean Springs, MS: Gulf State Marine Fisheries Commission. Retrieved from *http://www.gsmfc.org/publications/GSMFC%20Number%20202.pdf*.

VanZomeren, C.M., White, J.R., & DeLaune, R.D. (2012). Fate of Nitrate in Vegetated Brackish Coastal Marsh. *Soil Science Society of America Journal, 76*, 1919-1927. doi:10.2136/sssaj

Visser, J.M., Duke-Sylvester, S.M., Carter, J., & Broussard, W.P. (2013). A Computer Model to Forecast Wetland Vegetation Changes Resulting from Restoration and Protection in Coastal Louisiana. *Journal of Coastal Research*, 51-59 Retrieved from <Go to ISI>://WOS:000323471000005

Wang, H., Steyer, G.D., Couvillion, B.R., Rybczyk, J.M., Beck, H.J., Sleavin, W.J., Meselhe, E.A., Allison, M.A., Boustany, R.G., Fischenich, C.J., & Rivera-Monroy, V.H. (2014). Forecasting landscape effects of Mississippi River diversions on elevation and accretion in Louisiana deltaic wetlands under future environmental uncertainty scenarios. *Estuarine Coastal and Shelf Science, 138*, 57-68. doi:10.1016/j.ecss.2013.12.020

Waring, G.T., Josephson, E., Maze-Foley, K., & Rosel, P.E. (2015). *US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2014*. Woods Hole, MA. National Marine Fisheries Service, NOAA Tech Memo NMFS NE 231.

Wilber, D.H. & Clarke, D.G. (2001). Biological effects of suspended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. *North American Journal of Fisheries Management, 21*(4), 855-875. doi:10.1577/1548-8675(2001)021<0855:BEOSSA>2.0.CO;2

Wong, M.C., Peterson, C.H., & Piehler, M.F. (2011). Evaluating estuarine habitats using secondary production as a proxy for food web support. *Marine Ecology Progress Series, 440*, 11-25. doi:10.3354/meps09323

Woodward, R.T. & Wui, Y.-S. (2001). The economic value of wetland services: A meta-analysis. *Ecological Economics, 37*(2), 257-270

Zarnetske, P.L., Seabloom, E.W., & Hacker, S.D. (2010). Non-target effects of invasive species management: beachgrass, birds, and bulldozers in coastal dunes. *Ecosphere, 1*(5). doi:10.1890/ES10-00101.1

Zimmerman, R.J., Minello, T.J., & Rozas, L.P. (2000). Salt marsh linkages to productivity of penaeid shrimps and blue crabs in the northern Gulf of Mexico. In: M.P. Weinstein & D.A. Kreeger (Eds.), *Concepts and Controversies in Tidal Marsh Ecology.* Hingham, MA: Kluwer Academic Publishers.