Draft
Restoration Plan and Environmental Assessment

Bayou d'Inde, Calcasieu Parish, Louisiana

June 2023

Prepared by the:
National Oceanic and Atmospheric Administration
Louisiana Department of Environmental Quality
Louisiana Department of Wildlife and Fisheries
United States Fish and Wildlife Service

1 INTRODUCTION

This Draft Restoration Plan/Environmental Assessment (Draft RP/EA) was developed by the Louisiana Department of Environmental Quality (LDEQ), the Louisiana Department of Wildlife and Fisheries (LDWF), the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce, and the United States Fish and Wildlife Service (USFWS) acting on behalf of the U.S. Department of the Interior (DOI) (collectively, "the Trustees"[1]) to address natural resources (including ecological services) injured, lost, or destroyed due to releases of hazardous substances into Bayou d'Inde[2]. This Draft RP/EA is part of the Natural Resource Damage Assessment (NRDA) process being performed by the Trustees and is intended to inform the public about those injuries and restoration alternatives the Trustees considered to restore what was lost. This RP/EA also serves as an Environmental Assessment under the National Environmental Policy Act (NEPA), evaluating the reasonably foreseeable impacts of the preferred restoration actions on the quality of the physical, biological, and cultural environment in the Calcasieu River basin.

This Draft RP/EA describes the Trustees' assessment of the natural resource injuries attributable to hazardous substances released by the Settling Defendants (CITGO Petroleum Corporation, Occidental Chemical Corporation/OXY USA Inc.[3], and PPG Industries, Inc.) into Bayou d'Inde (Site). In October 2018 the Trustees and Settling Defendants completed a settlement to address these injuries. Per this settlement, the Settling Defendants provided $7,954,954 to fund natural resource restoration actions. This Draft RP/EA identifies preferred restoration actions the Trustees propose to fund with this settlement to partially compensate the public for those injuries.

The overall objective of the restoration process is to restore, rehabilitate, replace, or acquire the equivalent of natural resources and/or services lost due to the release of hazardous waste. Under

[1] The Louisiana Department of Natural Resources (LDNR) is also a designated state natural resource trustee in Louisiana, but, because the natural resource impacts covered by this plan are outside Louisiana's defined coastal zone, LDNR did not directly participate in its development. The Trustees, however, coordinated with and kept LDNR informed during the assessment and restoration planning process to ensure that there were no potential impacts to trust resources in the State's defined coastal zone due to hazardous substance releases within the scope of this assessment.

[2] The scope of the injury assessment in this Draft RP/EA reflects a threshold examination of the nature and extent of the contamination in the Calcasieu Remedial Investigation study area that could be attributed to hazardous substance releases from the CITGO Petroleum Corporation, Occidental Chemical Corporation, and PPG Industries, Inc. facilities. This examination led to an initial identification of areas of potential concern, including Bayou d'Inde. The potential for natural resource injuries in these areas was then evaluated in light of the presence of hazardous substances potentially from either facility at levels of concern (i.e., concentrations with potential to adversely affect natural resources or services). Areas in which the hazardous substances from the CITGO Petroleum Corporation, Occidental Chemical Corporation, and PPG Industries, Inc. facilities posed little or no potential for causing or contributing to injuries to natural resources were excluded from further analysis.

[3] Occidental Chemical Corporation and OXY USA Inc. are the same company according to the 2003 Final RI Report and the 2017 LDEQ Administrative Order. LDEQ has one Agency Interest Number (AI #) to Occidental Chemical Corporation/OXY USA Inc. (AI # 5337).

this Draft RP/EA, the Trustees are proposing the following alternatives to compensate the public for natural resource injuries:

- The Sabine National Wildlife Refuge Marsh Terracing Project: This project would benefit benthic organisms, fish, birds and other wildlife species by enhancing approximately 760 acres of coastal marsh habitat by constructing approximately 128,500 linear feet of earthen marsh terraces within Trapper Shack Lake and Rita Lake on Sabine National Wildlife Refuge (Sabine NWR) in southern Cameron Parish, approximately 24 miles south of Lake Charles, Louisiana.
- Mitigation Bank Acreage Purchase: This alternative would entail the purchase 30 - 40 acres of bottomland hardwood forest, coastal prairie, and fresh-intermediate marsh habitats within the South Fork Coastal Mitigation Bank to compensate for injuries to vegetated wetland and riparian habitats at the Site.
- Recreational Fishing opportunities: The Trustees propose using settlement funds to restore for lost recreational fishing opportunities by creating or enhancing infrastructure, access, and use opportunities. While the Trustees have not identified a specific restoration project to address this injury at this time, the Trustees are actively engaged in discussing potential opportunities with communities and local and State entities throughout the affected area. The Trustees will give notice and an opportunity to comment to the public when a suitable project or projects are identified.

1.1 AUTHORITY

This Draft RP/EA was prepared jointly by the Trustees pursuant to their respective authorities and responsibilities as natural resource trustees under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9601 *et seq*.; the Federal Water Pollution Control Act, 33 U.S.C. § 1251 *et seq*. (also known as the Clean Water Act or CWA); and other applicable federal or state laws, including Subpart G of the National Oil and Hazardous Substances Contingency Plan (NCP), at 40 C.F.R. §§ 300.600 through 300.615, and the CERCLA natural resource damage assessment regulations at 43 C.F.R. Part 11.

As a designated Trustee, each agency is authorized to act on behalf of the public under state and/or federal law to assess and recover natural resource damages and to plan and implement actions to restore, rehabilitate, replace, or acquire the equivalent of the affected natural resources and services injured as a result of the releases and/or discharges. Restoration activities are intended to return injured natural resources[4] and resource services[5] to baseline[6] conditions and to address the services that are lost to the public until restoration, is completed.

[4] Natural resources are defined as "land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any State or local government or Indian tribe, or any foreign government. (See 42 U.S.C. § 9601(16) and 43 C.F.R. § 11.14(z))

[5] Services (or natural resources services) means “the physical and biological functions performed by the resource including the human uses of those functions. These services are the result of the physical, chemical, or biological quality of the resource.” 43 C.F.R. § 11.14(nn).

[6] Baseline means “the condition or conditions that would have existed at the assessment area had the discharge of oil or release of the hazardous substance under investigation not occurred.” 43 C.F.R. § 11.14(e).

1.2 NEPA COMPLIANCE

Actions undertaken by federal Trustees to restore natural resources or services under CERCLA and other federal laws are subject to the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq.*, and the regulations guiding its implementation at 40 C.F.R. Parts 1500 through 1508.[7] NEPA and its implementing regulations outline the responsibilities of federal agencies when preparing environmental documentation. In general, federal agencies contemplating implementation of a major federal action must produce an environmental impact statement (EIS) if the action is expected to have significant impacts on the quality of the human environment. When it is uncertain whether the proposed action is likely to have significant impacts, federal agencies prepare an environmental assessment (EA) to evaluate the need for an EIS. If the EA demonstrates that the proposed action will not significantly impact the quality of the human environment, the agency issues a Finding of No Significant Impact (FONSI), which satisfies the requirements of NEPA, and no EIS is required. For a proposed restoration plan, if a FONSI determination is made, the Trustees may then issue a final restoration plan describing the selected restoration action(s).

In accordance with NEPA and its implementing regulations, this Draft RP/EA summarizes the current environmental setting; describes the purpose and need for restoration actions; identifies alternative actions; assesses their applicability and potential impact on the quality of the physical, biological and cultural environment; and provides the public an opportunity to participate in the decision-making process. NOAA is acting as the lead federal agency for NEPA compliance for this Draft RP/EA (40 C.F.R. § 1501.7), USFWS is a cooperating agency.

1.3 COMPLIANCE WITH OTHER AUTHORITIES

In addition to CERCLA and NEPA, other legal requirements may apply to natural resource damage assessment and restoration (NRDAR) planning or implementation. These may include:

Federal Laws and Executive Orders

- Endangered Species Act (16 U.S.C. § 1531 et seq.)
- Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801 et seq.)
- Marine Mammal Protection Act (16 U.S.C. § 1361 et seq.)
- Coastal Zone Management Act (16 U.S.C. § 1451 *et seq*.)
- National Historic Preservation Act (16 U.S.C. § 470 *et seq*.)
- Migratory Bird Treaty Act (16 U.S.C. § 703 *et seq*.)
- Bald and Gold Eagle Protection Act (16 U.S.C. § 668 *et seq*.)
- Clean Air Act (42 U.S.C. § 7401 *et seq*.)
- Federal Water Pollution Control Act (Clean Water Act) (33 U.S.C. § 1251 *et seq*.)
- Marine Protection, Research and Sanctuaries Act (16 U.S.C. § 1431 *et seq*. and 33 U.S.C. § 1401 *et seq*.)
- Estuary Protection Act (16 U.S.C. §§ 1221–1226)

[7] This EA is being prepared using the 1978 Council on Environmental Quality (CEQ) NEPA Regulations. NEPA reviews initiated prior to the effective date of the 2020 CEQ regulations may be conducted using the 1978 version of the regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14, 2020. This review began on September 10, 2020 and NOAA and DOI have decided to proceed under the 1978 regulations.

- National Marine Sanctuaries Act (16 U.S.C. § 1431 *et seq*.)
- Farmland Protection Policy Act (7 U.S.C. §§ 4201–4209)
- Rivers and Harbors Act (33 U.S.C. § 401 *et seq*.)
- EO 11988: Floodplain Management (augmented by EO 13690, January 30, 2015)
- EO 11990: Protection of Wetlands
- EO 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations[8]
- EO 12962: Recreational Fisheries
- EO 13007: Indian Sacred Sites
- EO 13112: Safeguarding the Nation from the Impacts of Invasive Species
- EO 13175: Consultation and Coordination with Indian Tribal Governments
- EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds
- EO 13693: Planning for Federal Sustainability in the Next Decade

State and Local Laws

- Archeological Finds on State Lands (R.S. 41:1605)
- Louisiana State and Local Coastal Resources Management Act (R.S. 49:214.21–214.42)
- Management of State Lands (R.S. 41:1701.1 et seq.)
- Louisiana Coastal Resources Program (LAC 43:I, Chapter 7)
- Louisiana Surface Water Quality Standards (LAC 33.IX, Chapter 11)
- Oyster Lease Relocation Program (LAC 76:VII, Section 531)
- Louisiana Scenic Rivers Program (R.S. 56:1856)

The Trustees will ensure compliance with authorities, consultations, and permitting applicable to the preferred restoration alternatives prior to implementation.

In addition to compliance with these statutes and regulations, the Trustees will consider relevant environmental or economic programs or plans that are ongoing or planned in or near the affected environment, and they will ensure that restoration projects neither impede nor duplicate such programs or plans. By coordinating restoration projects identified in this Draft RP/EA with other relevant restoration programs and plans, the Trustees will enhance the overall effort to restore and improve the environment and resources affected by the releases of hazardous substances at or from the Site.

1.4 PURPOSE AND NEED

The purpose of this Draft RP/EA is to identify and analyze the reasonable range of alternatives that the Trustees have developed to address natural resource injuries. The purpose and need for the restoration actions proposed in Section 5 in this Draft RP/EA is to restore natural resources

[8] This order requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The selected projects are not expected to adversely affect the environment or human health for any environmental justice populations in the vicinity of the projects. In January 2021, the Executive Branch of the United States issued additional Executive Orders relating to Environmental Justice. The federal Trustees reviewed the selected projects in the context of these Executive Orders and confirm that the selected projects are not expected to result in disproportionately high or adverse human health, environmental, climate-related or other cumulative impacts on disadvantaged communities.

and services lost to the public as a result of the releases of hazardous substances at or from the Site, and to compensate the public for the loss of those services.

1.5 PUBLIC PARTICIPATION

The Trustees prepared this Draft RP/EA for public review and comment. It provides the public with information on the natural resource injuries and service losses assessed in connection with the Site, the resource restoration objectives that guided the Trustees in developing this plan, the restoration alternatives that were considered, and the process used by the Trustees to identify the preferred restoration alternative. Public review of this Draft RP/EA is the means by which the Trustees seek comment on the proposed alternatives. As such, this Draft RP/EA is an integral and important part of the NRDAR process and is consistent with all applicable state and federal laws and regulations, including NEPA and its implementing regulations, and the regulations guiding assessment and restoration planning under CERCLA at 43 C.F.R. Part 11.

This Draft RP/EA is being made available for review and comment by the public for a period of 30 days. The deadline for submitting written comments is specified in one or more public notices issued by the Trustees to announce its availability for public review. Comments are to be submitted in writing via mail or email to:

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National Oceanic and Atmospheric Administration
Office of Habitat Conservation, Restoration Center
263 13th Avenue South
St. Petersburg, FL 33701
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(727) 221-4430

The Trustees will consider all written comments received within the comment period prior to approving and adopting a Final Restoration Plan/Environmental Assessment (Final RP/EA). Written comments received and the Trustees' responses to those comments, whether in the form of plan revisions or written explanations, will be summarized in the Final RP/EA.

1.6 ADMINISTRATIVE RECORD

The Trustees have maintained records documenting the information considered and actions taken by the Trustees during this assessment and restoration planning process. These records collectively comprise the Trustees' administrative record (AR) supporting this Draft RP/EA. Public comments submitted on this Draft RP/EA, as well as the Final RP/EA, will be included in this AR. The AR is available for review by interested members of the public on the Bayou d'Inde DARRP webpage (https://darrp.noaa.gov/hazardous-waste/bayou-dinde) and the Bayou d'Inde AR (https://www.diver.orr.noaa.gov/web/guest/diver-admin-record?diverWorkspaceSiteId=6221).

2 OVERVIEW AND BACKGROUND

This section provides a summary of the Calcasieu Estuary area affected by releases of hazardous substances by the Settling Defendants and summarizes the response actions that have been or are expected to be undertaken to address that contamination.

2.1 OVERVIEW OF THE SITE

The Calcasieu Estuary is located near Lake Charles in Calcasieu Parish, Louisiana (LA) (Figure 1.1). The estuary and its associated tributaries comprise a large, tidally influenced wetland system approximately 40 miles in length, extending north from the Gulf to the saltwater barrier upstream of Lake Charles. The system is an important nursery area for and supports an abundant array of fish and wildlife species. The estuarine portion of the watershed extends from the saltwater barrier, north of Lake Charles, to the Gulf. The Calcasieu Estuary is characterized by a number of distinctive physical features, including Lake Charles, Prien Lake, Moss Lake, and Calcasieu Lake. The Calcasieu River/Calcasieu Ship Channel has several tributaries within the estuary, the most notable being Bayou Verdine, Contraband Bayou, Bayou d'Inde, and Bayou Olsen. The Intracoastal Waterway connects the Calcasieu Estuary with the Sabine Lake system to the west, and Grand Lake to the east.

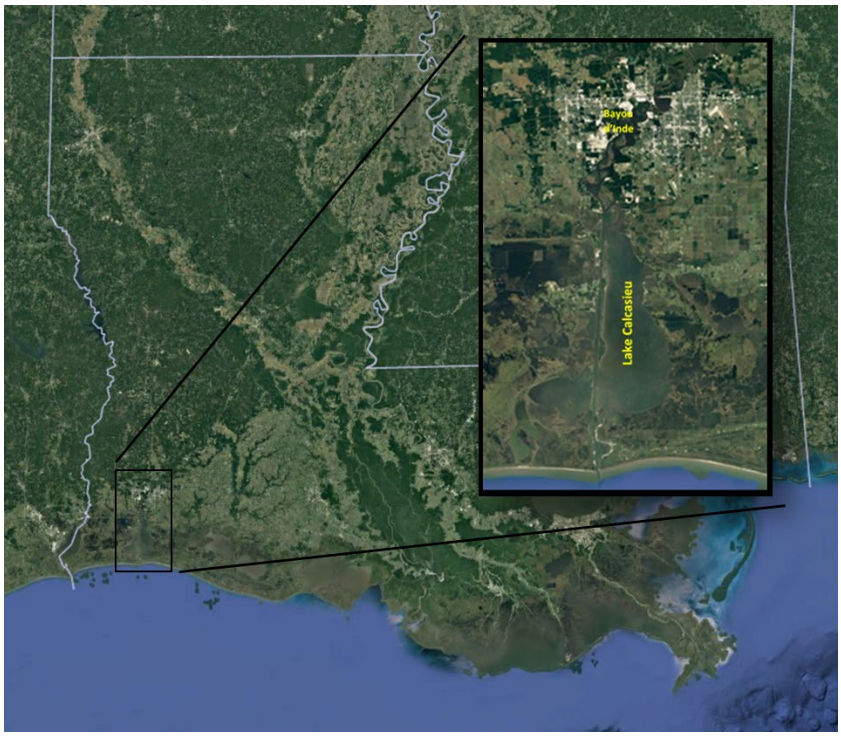

Figure 1.1. Lower Calcasieu River estuary and Bayou d'Inde, Louisiana.

Land surrounding the Calcasieu Estuary includes undeveloped, rural, residential, commercial, and heavy industrial properties. Heavy industry dominates the southern reaches of Bayou d'Inde and both sides of Bayou Verdine. Permitted discharge outfalls (as identified in the National Pollution Discharge Elimination System; NPDES), as well as agricultural and industrial drainage ditches (including the Vista West Ditch, the Faubacher Ditch, PPG Canal, and the Kansas City Southern Railroad West Ditch), discharge to the estuary. Current and historic point source discharges, storm water runoff, and accidental spills contributed to the contamination of surface water, sediment, and biota within the estuary and raised questions regarding the potential for adverse effects on ecological receptors (Curry et al. 1997; Sinclair et al. 2016).

Contamination of Bayou d'Inde began in the 1940s, prior to implementation of environmental protection regulations in the early 1970s. In 1988, industrial waste generators that discharged potential hazardous waste into the bayou were identified and include: PPG Industries, CITGO, Texas Butylene, Firestone Synthetic Rubber and Latex Co., Westlake Polymers, Occidental Chemical Corporation, Himont, USA, Olin Corporation, W.R. Grace Company, and BFI Chemical Services Inc. Collectively these facilities generated inorganic and halogenated organic compounds, chlorinated hydrocarbons, Methyl ethyl ketone (MEK), phenols, butadiene, halogenated or non-halogenated solvents, chromium, benzene, agrochemicals, solid waste with Extraction Procedure toxicity characteristics, and petroleum refinery sludge. Several of the aforementioned facilities held NPDES discharge permits that released to Bayou d'Inde. Hazardous substances were documented in sediment, surface water, groundwater, and biota in a USEPA 1988 site inspection report (EDMS document # 329919). Hazardous substances documented during this inspection included: phenols, metals, chlorinated hydrocarbons and polychlorinated biphenyl (PCB). The United States Geological Survey (USGS), LDEQ, and the Louisiana Department of Health and Hospitals [now known as Louisiana Department of Health (LDH)] determined impacts of hazardous substances to these media based on sample collection and analyses.

Bayou d'Inde is a major tributary to the Calcasieu River, flowing east-southeast for 10 miles from its headwaters in western Sulphur, LA to its confluence with the Calcasieu Ship Channel southwest of Coon Island and south of the I-210 Bridge in Lake Charles, LA (MESL 2004, USEPA 2003, LDEQ 2013) (Figure 2.1). It is a perennial riverine system joined by several tributaries, including Maple Fork and the manmade PPG Canal. The bayou flows though wooded, residential, light commercial, and heavy industrial areas. The lower portion of the bayou to the east of LA Highway 108 (LA-108) is characterized by fringe marsh. Regulated outfall areas from industrial facilities are common along the bayou. Lockport Marsh is located at the confluence of Bayou d'Inde and Calcasieu Ship Channel and is saline.

Figure 2.1. Bayou d'Inde and surrounding estuary.

2.2 THE CITCO PETROLEUM CORPORATION, OCCIDENTAL CHEMICAL CORPORATION, AND PPG INDUSTRIES, INC. FACILITIES

In 1999, the United States Environmental Protection Agency (USEPA) began a Remedial Investigation (RI) to identify contamination in the Calcasieu Estuary. The Final RI Report in

2003 determined that portions of Bayou d'Inde had been contaminated with hazardous substances from various releases and discharges (LDEQ 2013). Several Settling Defendants including CITGO Petroleum Corporation, Occidental Chemical Corporation/OXY USA Inc., and PPG Industries, Inc. were deemed accountable for contamination to environmental media including sediment, surface water, and biota. The contaminates found in Bayou d'Inde and surrounding wetlands include polycyclic aromatic hydrocarbons (PAHs), PCBs, metals, mercury, and dioxins (LDEQ 2011).

2.2.1 CITGO PETROLEUM CORPORATION

The CITGO Petroleum Corporation owns and operates the 1,600-acre Lake Charles manufacturing complex. The facility is located about six miles southwest of Lake Charles along the west bank of the Calcasieu Ship Channel on the south bank of Bayou d'Inde. Predecessors to CITGO constructed a petroleum refinery at the site in the early 1940s, the Lube Oil Plant in 1949, and the Petrochemical Plant in the mid-1950s. The current CITGO complex includes three manufacturing operations: the refinery, lubricating oil plant, and propylene fractionation unit (PFU). The CITGO petroleum refinery has the capacity to process 320,000 barrels of crude oil per day. CITGO managed the petrochemical division that discharged to the bayou through 1985.

CITGO is currently permitted to discharge treated wastewater from the Lube Plant and stormwater runoff from the PFU to Bayou d'Inde through two outfall areas.

2.2.2 Occidental Chemical Corporation

In 1985 Occidental Petroleum Corporation purchased the Petrochemical Division Plant owned by Cities Service. The 300-acre facility is located on the south side Bayou d'Inde. The plant originally consisted of two ethylene/propylene units. A portion of the plant contained two polyethylene plants, which were sold to another company in 1987. Occidental leased the ethylene/propylene unit to CITGO who modified the plant into a PFU. As of 2003, Occidental operated one ethylene/propylene unit that has the capacity to produce 500 million pounds of ethylene and 150 million pounds of propylene annually.

Occidental is permitted to discharge from three outfalls into Bayou d'Inde. The discharge outfalls contain various treated waste, stormwater discharge from the south portion of the facility including sanitary wastes, and stormwater runoff from the northwest portion of the facility.

2.2.3 PPG Industries, Inc.

The PPG Industrial, Inc. facility is located to the north of Bayou d'Inde and Lockport Marsh. Industrial chemical manufacturing began at the site in the early 1940's by the United States government, Matheson Alkali Works, and Alkali Corporation (USEPA 2003). PPG acquired the site in 1968 and manufactured various chemicals, including chlorinated hydrocarbons and precipitated silica (USEPA 2003). In 2003, PPG operated three major process areas including Chlor-Alkali Plant, the Derivatives Plan, and the Chor-Alkalie/Silicas area (USEPA 2003). PPG has two material storage and transfer areas on site, the South Terminal area and the North Dock area.

PPG is permitted to discharge process wastewater to the PPG Canal, which empties into Bayou d'Inde. The PPG Canal originates in the southwest corner of the PPG facility and flows to the

southwest into Bayou d'Inde. Surface flow and process water from all areas, except the North Dock area, flow to the PPG Canal. Three other small generators are permitted to discharge to PPG Canal. Between 1979 and 1998, PPG had several permit violations for the discharge of chlorinated hydrocarbons, lead, copper, and mercury. The most contaminated portion of the canal was re-routed in 1994.

2.3 SUMMARY OF RESPONSE ACTIONS

Over the years, the Calcasieu Estuary has been the subject of a number of investigations and environmental response actions under the direction or oversight of the USEPA and/or LDEQ. The most extensive effort to identify the nature and extent of hazardous substances present in the Calcasieu Estuary to date was the USEPA-led RI of contaminants in sediments, surface water and biota in the Calcasieu Estuary completed in 2002 (USEPA 2003). That investigation focused on four Areas of Concern (AOCs) within the estuary: Bayou d'Inde, Bayou Verdine, Upper Calcasieu River (starting with the salt water barrier) and the Lower Calcasieu River (including Indian Marais Lagoon and ending at Moss Lake). The AOC boundaries were developed in the early stages of the RI and aided in management and evaluation of the full study area.

The Bayou d'Inde AOC contains the portion of the bayou from the confluence of Little Bayou d'Inde to the Calcasieu River Ship Channel, including the fringe marshes along the banks of Bayou d'Inde downstream of the LA-108 bridge (including near the confluence of Maple Fork) to the 470-acre Lockport Marsh located at the confluence of Bayou d'Inde and the Calcasieu Ship Channel. The AOC encompasses the 9.9 miles of the bayou, bounded downstream at its confluence with the Calcasieu Ship Channel and upstream at the confluence with Little Bayou d'Inde, including the Bayou d'Inde channel and its tributaries and each of their associated surface waters, sediments, soils, biota, adjoining shorelines and banks, riparian habitats, and wetlands (see Figure 2.2).

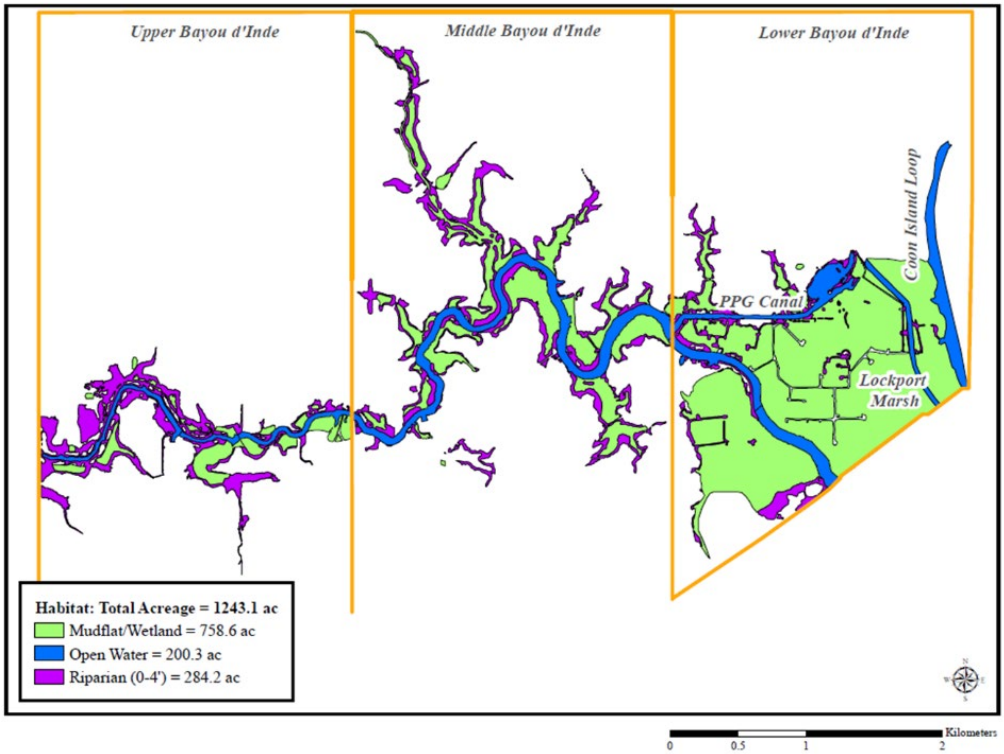

Figure 2.2. Mudflat/wetlands, open water and riparian habitat within the Bayou d'Inde Area of Concern.

The information provided by the RI was used by USEPA and LDEQ to assist in planning and to inform decisions regarding appropriate clean-up actions in the estuary. Bayou d'Inde was divided into four Areas of Interest (AOI) and those AOIs were split into two areas. AOI 1 consist of the portion of Bayou d'Inde from its confluence with Little Bayou d'Inde to LA-108. AOI 2 consist of the dredged main channel of Bayou d'Inde between LA-108 and its confluence with the Calcasieu River Ship Channel. AOI 3 is the fringe marshes along the banks of Bayou d'Inde between LA-108 and PPG Canal. AOI 4 is the Lockport Marsh, along both banks of Bayou d'Inde below the PPG Canal. Area A is made up of AOI 1 and the portions of AOI 2 and AOI 3 upstream of Bayou d'Inde Pass Road and the location of the former Bayou d'Inde Pass Road Bridge. Area B is made up of the portions of AOI 2 and AOI 3 downstream of Bayou d'Inde Pass Road and the location of the former Bayou d'Inde Pass Road Bridge, and AOI 4. As a result of the RI, two remedial actions consisting of a combination of sediment removal and capping were implemented to address contamination within Bayou d'Inde. Under a Cooperative Agreement with LDEQ, CITGO and Occidental Chemical Corporation/Oxy USA, Inc. designed and implemented a remedy for Area A. Remediation activities for Area A were conducted in 2018 and included sediment capping activities. In-situ capping of approximately 36,000 square yards of bayou sediment with articulated concrete block mat (ACBM) to control exposure and potential migration of sediment with potentially elevated PCB concentrations was implemented as the remedial action at AOI 1 (Anchor QEA 2017; Anchor QEA 2018). The placement of 6 inches of clean cover material over approximately 15.8 acres was the remedy for the fringe marsh located in Upper AOI 3 (Anchor QEA 2017). In a separate cooperative agreement with LDEQ, PPG Industries, Inc. (now Westlake Chemical) implemented a remedy for Area B that included dredging the lower portion of Bayou d'Inde, placing a sediment cap on the lower canal portion of the PPG Canal, and placing clean sediment cover on fringe marsh and Lockport

Marsh. Nearby sediment sources were used as cover material for Area B. These remediation activities were completed in 2015 (Anchor QEA 2016).

The remediation activities described above are expected to meet the remedial goal for the Bayou d'Inde AOC. The Trustees will continue to work with the USEPA to ensure response decisions and plans are protective of natural resources and expect that natural resources affected by the hazardous releases will return to baseline conditions within a reasonable period of time. Response activities, however, do not compensate the public for resource injuries or losses caused by these hazardous substances, including any losses of resources or resource services pending recovery or due to response actions undertaken (e.g., the removal of sediments within the bayou).

3 AFFECTED ENVIRONMENT

The Trustees focused restoration planning in the area of release (Bayou d'Inde) and surrounding estuary. This section therefore provides information on the physical, biological, and cultural environments within the Calcasieu Estuary, which serves as the basis for the Trustees' evaluation of the potential environmental impacts of the restoration alternatives listed in Section 5 (Restoration Alternatives Comparison) as well as the potential impacts of the preferred alternative, discussed in Section 6. The scope of the environmental impacts addressed in this Draft RP/EA include those on wildlife, fish and invertebrates, essential fish habitat, threatened and endangered species, public access and recreation resources, water and sediment quality, air quality, visual resources, cultural resources, climate, environmental justice, and economy, land use, and transportation.

3.1 PHYSICAL ENVIRONMENT

The affected environment is located within the Calcasieu River Basin. The Calcasieu River and its associated tributaries comprise a large, tidally influenced wetland ecosystem (or estuary) approximately 40 miles in length, extending north from the Gulf to the saltwater barrier upstream of Lake Charles, Louisiana. The estuary was initially formed as a bay in the drowned river valley of the Calcasieu River during the Holocene. The lower end of the river was naturally blocked by a bar formation, with only a small tidal pass outlet. Before the bar was removed and the channel dredged for navigation, the lakes and adjacent marshes were largely freshwater. Now, the estuary is comprised of a complex interconnected system of bayous, bays, shallow lakes, and dredged ship channels fringed by saline and brackish marshes. The predominant hydrologic components of the estuary include Lake Charles, Prien Lake, Moss Lake, and Calcasieu Lake, and major tributaries of the system include Bayou d'Inde, Bayou Verdine, Bayou Contraband, and Bayou Choupique.

The estuary is largely nestled among urban districts of Calcasieu and Cameron Parishes. The upper estuary in Calcasieu Parish is heavily developed and highly industrialized. The Calcasieu Ship Channel, a dredged navigational channel, is maintained within the Calcasieu River between 35 to 42 feet in depth, with the channel increasing in depth as it approaches the Gulf. This channel serves as the marine industrial transport corridor from the Port of Lake Charles to the Gulf. The active portion of the ship channel is routinely dredged, at an average of once every two to four years. The Calcasieu River has a tidal range of two feet at its mouth that decreases in amplitude as the channel proceeds upriver.

The lower portion of the estuary is largely comprised of undeveloped coastal marshes, habitat that provides essential support for many species of fish and wildlife. Two national wildlife refuges are located in the lower estuary – the Sabine National Wildlife Refuge (NWR) and the Cameron Prairie NWR. These areas are owned and managed by the USFWS for conservation and protection of natural resources.

The lakes and river channel bottoms consist mainly of sand and gravel deposits, natural levees of fine sands, and mud deposits with organic-rich muddy backswamp deposits between them. The silt is typically black with plant and shell fragments. Sediments generally become finer and more

stable in the upstream reaches of the estuary where vegetation is more prevalent and tidal surge tends to be lowest.

The Calcasieu Estuary has been impacted by industrial development, including through discharges and other types of contaminant releases. The nature and extent of hazardous substances in the estuary was extensively investigated in the RI process, by four major component areas (Figure 3.1):

Upper Calcasieu River – This area includes a large, industrial ship canal approximately 15 miles in length and occupying 2,871 acres. It includes Lake Charles, the upper Calcasieu River and shipping channel, and the Coon Island Loop.

Lower Calcasieu River – This area includes another large, industrial ship canal extending 8 miles in length from Coon Island to the outflow of Moss Lake and occupying 3,976 acres. It includes Prien Lake, Moss Lake, the Calcasieu ship canal, and the old channel of the Calcasieu River.

Bayou d'Inde – This is the narrow, sinuous channel, approximately 9 miles in length that ends at its confluence with the Calcasieu River. It occupies 1,486 acres. Most of the bayou area is uncharacterized, back-water marsh located southwest of the city of Lake Charles.

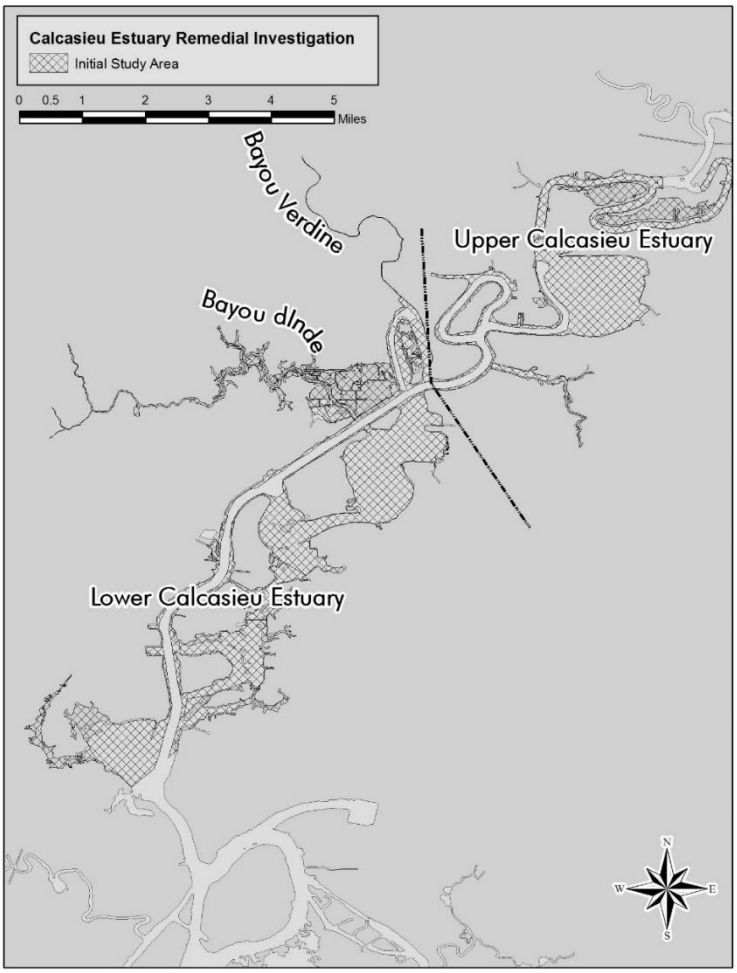

Figure 3.1. Four Major Component Areas Investigated in the Bayou d'Inde Remedial Investigation Process.

Bayou Verdine – This is a small tributary of the Calcasieu River, which enters the river at the north end of the Coon Island Loop, after winding 4.2 miles through residential and industrial areas.

The physical characteristics of the estuary make it quite diverse. The estuary is comprised of a variety of different types of water bodies and it ranges over approximately 40 miles from north to south. The waters of the estuary range from freshwater to saline and cross through industrial and rural settings. The energy of the system ranges from lotic (river) to lentic (lakes). These factors all contribute to the diversity of habitats found in the system.

Two National Wildlife Refuges are also located in the lower Calcasieu River estuary – Sabine and Cameron Prairie NWRs. Those NWRs were created to support, protect, and provide winter habitat for migratory waterfowl. They are also managed for the conservation and protection of other natural resources in the region.

3.2 WATER QUALITY

As part of the Surface Water Monitoring Program, LDEQ routinely monitors 25 parameters on a monthly basis using a four-year cycle fixed site network, as well as a long-term network of 21 sites (LDEQ 2022). Data are systematically collected on selected water subsegments defined in the Surface Water Quality Standards (LAC 33:IX, Chapter 11). Each year of the four-year cycle runs from October through September for a given set of sites before changing to the next set. Long-term network sites are sampled every month and year regardless of the four-year cycle. Based on those data and the use of less-continuous information, such as fish consumption and swimming advisories, the LDEQ assesses water quality fitness for the following uses: primary contact recreation (swimming), secondary contact recreation (boating), fish and wildlife propagation (fishing), drinking water supply, outstanding natural resource use, agriculture, and shellfish propagation (LDEQ 2022). Based on existing data, water quality is determined to be either fully supporting or not supporting those uses.

The LDEQ currently maintains three water quality monitoring sites, Black Bayou and two Intracoastal Waterway subsegments near the projects considered by the Trustees. All sites are part of the four-year cycle network. Based on the 2022 Louisiana Water Quality Inventory: Integrated Report, Black Bayou and Intracoastal Waterway subsegment LA031002_00 are both impaired for primary contact recreation, while Intracoastal Waterway subsegment LA031101_00 fully supports all designated waterbody uses (Table 3.1).

Table 3.1. Combined monitored and evaluated assessments of water quality for Black Bayou and two Intracoastal Waterway subsegments (LDEQ 2022).

Subsegment Number	Subsegment Description	Primary Contact Recreation	Secondary Contact Recreation	Fish and Wildlife Propagation
LA110602_00	Black Bayou-From ICWW to Pirogue Ditch (Estuarine)	Not Supporting	Full	Full
LA031002_00	Intracoastal Waterway-From West Calcasieu River Basin boundary to Calcasieu Lock (Estuarine)	Not Supporting	Full	Full
LA031101_00	Intracoastal Waterway-From Calcasieu River to Creole Canal at Gibbstown	Full	Full	Full

3.3 AIR QUALITY

The Air Field Services Section of LDEQ maintains a statewide monitoring network that consists of 41 stationary ambient air-monitoring stations. The data collected are used to determine compliance with national ambient air quality standards (NAAQS) and track trends in air quality. The USEPA's Office of Air Quality Planning and Standards set NAAQS for six principal pollutants considered harmful to public health and the environment. Termed criteria pollutants, the six are: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO2), ozone (O3), particulate (PM2.5 and PM10), and sulfur dioxide (SO2). Volatile organic compounds, many of which are hazardous air pollutants, are not listed as criteria air pollutants but are measured at selected sites throughout Louisiana. There are 4 ambient air monitoring sites in Calcasieu Parish (none in Cameron Parish). Ambient air monitoring data and reports are available online through LDEQ's website: https://www.deq.louisiana.gov/page/ambient-air-monitoring-data-reports.

The Clean Air Act established two types of national air quality standards: primary and secondary. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. A geographic area that meets or exceeds primary standards is classified as an attainment area. Areas that violate NAAQS for one or more of the six criteria pollutants are classified as nonattainment areas. Information on nonattainment/maintenance status for each parish by year can be accessed at: https://www3.epa.gov/airquality/greenbook/anayo_la.html. Table 3.2 provides standards for each pollutant and attainment status for Louisiana.

Table 3.2. National Ambient Air Quality Standards (USEPA n.d.) and Louisiana Attainment Status (LDEQ n.d.). Units of measure for the standards are parts per million (ppm) or parts per billion (ppb) by volume, milligrams per cubic meter of air (mg/ m3), and micrograms per cubic meter of air (µg/m3).

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	Attainment Status
Carbon Monoxide	Primary	8 – hour 1 – hour	9.0 ppm 35.0 ppm	Not to be exceeded more than once per yr	Attainment
Lead	Primary and Secondary	Rolling 3 month avg	0.15 µm/m^3 (1)	Not to be exceeded	Attainment
Nitrogen Dioxide	Primary Primary and Secondary	1 – hour Annual	100.0 ppb 53.0 ppb (2)	98th percentile of 1 – hr daily max conc, avgd over 3 yrs Annual mean	Attainment
Ozone	Primary and Secondary	8 – hour	0.070 ppm (3)	Annual 4th highest daily max 8 hr concentration avgd over 3 yrs	Attainment

Particle Pollution PM2.5	Primary Secondary Primary and Secondary	Annual 24 hour	12.0 µm/m^3 15.0 µm/m^3 35.0 µm/m^3	Annual mean avgd over 3 yrs 98th percentile, avgd over 3 yrs	Attainment
Particle Pollution PM 10	Primary and Secondary	24 – hour	150.0 µm/m^3	Not to be exceeded more than once per yr on avg over 3 yrs	Attainment
Sulfur Dioxide	Primary Secondary	1 – hour 3 – hour	75.0 ppb (4) 0.5 ppm	99th percentile of 1 – hr daily max conc avgd over 3 yrs Not to be exceeded more than once per yr	Non-attainment for St. Bernard Parish only

(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m^3 as a calendar quarter average) also remain in effect.

(2) The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O_3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(4) The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2) any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO_2 standards (40 CFR 50.4(3)). A SIP call is a USEPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required NAAQS.

3.4 NOISE

The Noise Control Act of 1972 (42 U.S.C. § 4901 *et seq*.) authorized the establishment of Federal noise emission standards for commercially distributed products, established a means for effective coordination of Federal noise-control research and activities, and serves to provide information to the public regarding noise emissions. There are many different sources of noise in and near the Site and proposed restoration project areas including, but not limited to: commercial

and recreational boats, transportation noise, construction noise, and industry-related noise (such as oil and gas facilities and light industry). Transportation noise includes traffic noise from automobiles, trucks, and motorcycles; railway transportation services; and aircraft (including helicopters) take-offs, landings, and overflights from public and private airfields. Construction noise is created during a variety of activities including demolition projects, site preparation (e.g., land clearing, grading, excavation, cultch placement), and repair and maintenance activities. These actions can result in relatively high noise levels within several hundred feet of the activity. Noise levels generated will fluctuate depending on the type, number, and duration of use of heavy equipment for construction activities and can differ in effect by the type of activity, existing site conditions (vegetation to buffer sound), and existing ambient noise levels.

3.5 BIOLOGICAL ENVIRONMENT

The Calcasieu Estuary provides important habitat for wildlife including resident and migratory waterfowl, shorebirds, and wading birds and also serves as a valuable nursery and breeding habitat for numerous estuarine-dependent sport and commercial fish and shellfish. The Calcasieu region, including Calcasieu Lake and its surrounding environment, has several types of habitats including estuary habitats of various salinities; fresh, intermediate, brackish, and salt marshes; and coastal forests.

From 1932 to 2016, the Calcasieu/Sabine Basin lost approximately 200 mi^2 of its coastal wetlands. This estimated land loss is based on land area analyses using historical U.S. Army Corps of Engineers (USACE) land loss data, aerial photography data, and satellite imagery data (Couvillion et al. 2017). A combination of human-induced and natural processes has contributed to land loss in the project area. This includes saltwater intrusion, hydrologic modifications of the Calcasieu basin, oil and gas extraction and infrastructure, storm-driven erosion, subsidence, and sea level rise. Persistent flooding of marshes from sea-level rise combined with saltwater intrusion from the Gulf through the Calcasieu River and subsidence in the basin is deteriorating wetlands and causing land loss.

3.5.1 Salt Marsh

Salt marshes can be found around the margins of sounds and estuaries, on the bay sides of barrier islands, and in old flood tide deltas near closed inlets with regular saltwater tides. Salt marsh vegetation is dominated by smooth cordgrass (*Spartina alterniflora*) at the lower elevations (low marsh) typically between mean low tide and mean high tide. Zonation of vegetation occurs between mean tide and mean high tide with zones of black needlerush (*Juncus romerianus*), smooth cordgrass, and sometimes other brackish marsh species. Salt marsh communities are highly productive due to the dynamic environment in which they are found. In this setting, organic matter is regularly removed and sediment deposited by the tides. Under optimal conditions (i.e., presence of a coarse-grain sediment source) tidal sedimentation causes a rise in the marsh surface and landward migration of the marsh. Sediment may also be deposited on the shoreline, causing estuarine-ward progradation of the marsh. Marshes on the bay sides of barrier islands may be subject to episodic burial by sand overwash. Salt marshes are distinguished from all other community types by the dominance of smooth cordgrass, as well as by their tidal, saltwater environments. Relatively narrow zones of brackish marsh at the upper edge are considered part of the salt marsh, but larger expanses in the heads of creeks and in the interior of large marsh islands are considered separate brackish marsh communities.

3.5.2 Brackish/Intermediate Marsh

This marsh type is found along the margins of sounds and estuaries that are somewhat removed from connection with the sea, such that salinity is diluted by freshwater inflow and tidal range is generally less than in salt marshes. Those marshes in areas with substantial regular lunar tides have a regular input of nutrients, which makes them highly productive. In addition to a high inflow of nutrients, regularly flooded marshes are typically supplied with abundant sediment and may produce tidal mud flats and estuarine-ward progradation of the marsh. Areas with only irregular wind tidal flooding have much less nutrient input, less mineral sedimentation, and accumulate relatively more organic matter. They lack mud flats and their estuarine edges are scarped and erosional. As sea level rises, mineral or organic sedimentation causes the marsh surface to rise; the landward edge will migrate landward; and changes in tidal inlets may cause changes in salinity.

Brackish marshes are distinguished by their tidal environment and usually by the dominance of marsh hay cordgrass (*Spartina patens*). There is a primary difference in dynamics between the regularly flooded marshes in the southern portion of the coastal zone and the predominantly irregularly flooded marshes in the northern coastal zone. Areas exposed to wave action from large estuaries may also be different in dynamics from narrow marshes in small tributaries.

3.5.3 Tidal Freshwater Marsh

This marsh type is found at the margins of estuaries, or drowned rivers and creeks, where they are regularly or irregularly flooded with freshwater tides. Historically, this marsh type was extensive, but its range has steadily reduced since the mid-1950s due to numerous factors including subsidence, sea-level rise, saltwater intrusion, and altered hydrology as a result of river leveeing and oil and gas access canals. Tidal freshwater marshes are sustained largely through tidal flooding, which brings in nutrients derived from seawater and varying amounts of sediment to the community. Regularly flooded marshes are reported to have high productivity, equivalent to salt marshes at the same latitude (Odum et al. 1984). Irregularly flooded marshes and marshes in areas with little mineral sediment are assumed less productive. Tidal freshwater marsh is distinguished from adjacent swamp forest and upland forests by the lack of a dominant tree or shrub layer. These marshes have a very high diversity of plant species such as, cattail (*Typha latifolia*), water lilies (*Nymphaeaceae sp.*), irises (*Iris sp.*), and bulltongue (*Sagittaria lancifolia*).

3.5.4 Wetland Forest (Evergreen, Deciduous, and Mixed)

Wetland forests, besides being broken into evergreen, deciduous, and mixed are segmented by their flooding frequency. Those areas that experience permanent to semi-permanent flooding are deepwater swamps while those receiving only seasonal riverine pulses are generally characterized as bottomland hardwood (BLH) forests. The distinction is not only made because of flooding regime, but the species composition that occurs as a result. In Louisiana, the bald cypress (*Taxodium distichum*) and tupelo (*Nyssa* spp.) swamps are the major deepwater forested wetlands and are characterized by bald cypress – water tupelo communities with permanent or near permanent standing water (Mitsch and Gosselink 1993). Bottomland hardwood forests usually occur as an ecotone between aquatic and upland ecosystems but have distinct vegetation and soil characteristics. The vegetation in BLH forests is dominated by diverse trees adapted to the wide variety of environmental conditions on the floodplain. Typical species are black willow

(*Salix nigra*), red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), laurel oak (*Quercus laurifolia*), American elm (*Ulmus americana*), and sweetgum (*Liquidambar styraciflua*).

3.5.5 Cheniers

Cheniers are coastal ridges exclusive to western Louisiana. Because of their relatively high elevation (some up to several meters tall), these ridges are historically known for supporting maritime forests dominated by live oaks (*chenier* is French for oak). Chenier forests play an important ecological role as a temporary habitat for many migrating species and serve as one of the more important continuous habitats for mammals and birds in coastal Louisiana.

3.5.6 Aquatic Biota

The Calcasieu Estuary supports a diverse assemblage of aquatic life, including plants (both vascular and non-vascular) and animals (invertebrates, fish, birds, mammals, reptiles, etc.). These organisms depend upon the estuary to provide habitat for foraging, mating, rearing young, and other important life functions. Several of the organisms found within the Calcasieu Estuary are among those vital to the economy of Louisiana, as well as a significant element of outdoor recreational opportunities publicized by the state.

Among the great variety of fish found in the Gulf are red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), pinfish (*Lagodon rhomboides*), sheepshead (*Archosargus probatocephalus*), sand seatrout (*Cynoscion arenarius*), spotted seatrout (*Cynoscion nebulosus*), silver seatrout (*Cynoscion nothus*), Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), striped mullet (*Mugil cephalus*), white mullet (*Mugil curema*), sea catfish (*Arius felis*), gafftopsail catfish (*Bagre marinus*), bay anchovy (*Anchoa mitchilli*), and southern flounder (*Paralichthys lethostigma*) (Calcasieu BERA, USEPA 2003). These species spend (at a minimum) a portion of their life cycle in the estuary, primarily during spawning, and many are fished commercially. Various species migrate into bayous to spawn and hatch their young. The quiet, less saline upper reaches of the estuary provide habitat for these hatchlings, nurturing them into juveniles. The hatchlings return to the Gulf as young adults to complete their growth cycle.

Phytoplankton, zooplankton, and aquatic invertebrates living in the estuary provide food for several fish and bird species. Phytoplankton consists of various forms of algae (green, red, and brown species), diatoms, desmids, euglenoids, and cyanobacteria (formerly blue-green algae) (USEPA 2003). Zooplankton consists of various animals ranging from primitive forms such as protozoans to more complex animals such as crustaceans and insects. Smaller zooplankton commonly found in the estuary include calanoid copepods, barnacle larvae, and shrimp (USEPA 2003). The Calcasieu Estuary also contains a variety of larger zooplankton including brown shrimp (*Farfantepenaeus aztecus*), white shrimp (*Litopenaeus setiferus*), brackish grass shrimp (*Palaemonetes intermedius*), grass shrimp (*Palaemonetes kadiakensis*), blue crab (*Callinectes sapidus*), Gulf crab (*Callinectes similis*), western stone crab (*Menippe adina*), squid (*Lolliguncula brevis*), and crayfish (*Procambarus* sp.) (USEPA 2003).

The sediments within the Calcasieu Estuary support benthic organisms, including annelid worms, small crustaceans (amphipods, isopods, copepods, and juvenile decapods), mollusks, and other small bottom-dwellers in salt marshes and un-vegetated sub tidal sediments. Among these benthic organisms are herbivores (eating algae or other live plant material), detritivores (feeding

on decaying organic matter in surface sediments or sediment-bound nutrients and organic substances that are not generally available to epiphytic or pelagic organisms), carnivores (preying on other benthic organisms), and omnivores (a combination). These organisms provide the nutritional base for developing stages of many finfish and shellfish and, thus, affect all trophic levels in the estuary.

3.5.7 Terrestrial Biota

The southern marshes and swamps of Louisiana are the home of a wide variety of wildlife. White-tailed deer (*Odocoileus virginianus*) are abundant throughout the state. Common small mammals include bats (order Chiroptera), rabbit (*Sylvilagus aquaticus*), raccoon (*Procyon lotor*), eastern fox squirrel (*Sciurus niger*), nutria (*Myocastor coypus*), and river otter (*Lutra canadensis*) (USEPA 2003). The more remote areas of the swamp contain muskrats (*Ondatra zibethicus*) and mink (*Mustela vison*) in addition to other fauna.

More than one-half of the bird species of North America are resident in the state or spend a portion of their migration there. Common water birds found in coastal Louisiana include laughing gull (*Larus atricilla*), royal tern (*Sterna maxima*), brown pelican (*Pelecanus occidentalis*) and black skimmer (*Rynchops niger*). Birds found in coastal marshes include marsh wren (*Cistothorus palustris*), seaside sparrow (*Ammodramus maritumus*), red-winged blackbird (*Agelaius phoeniceus*), Wilson snipe (*Charadrius wilsonia*), woodcock (*Scolopax minor*), several rail species (*Rallus* spp., *Lewinia* spp., *Gallirallus* spp., *Laterallus* sp., and *Coturnicops* sp.) and species of sandpipers (*Actitis* spp.).

Alligators (*Alligator mississippiensis*) are common in southern Louisiana swamps; one was spotted in the Lower Calcasieu study area during the RI. Other reptiles found in the affected area include turtles, lizards, and both poisonous and non-poisonous snakes. Snakes found in Louisiana include the coral snake (*Lampropeltis getula holbrooki*), western pygmy rattler (*Sistrurus miliarius streckeri*), canebrake rattler (*Crotalus horridus*), copperhead (*Agkistrodon cantortrix*), Texas rat snake (*Elaphe obsolete lindheimeri*), speckled kingsnake (*Lampropeltis getula holbrooki*) and water moccasin (*Agkistrodon piscivorus*). Common reptiles also found within the terrestrial areas include the ground skink (*Scincella lateralis*) and red-eared slider (*Chrysemys scripta elegans*) (USEPA 2003).

3.6 CULTURAL AND HUMAN ENVIRONMENT

Since the 1790s, a variety of cultures have existed in this region, including Native American, German, Spanish, French, British, Acadian (Cajun), African and Creole. The economy of the area has its origins in the abundant natural resources found within the parish. The early economy was based upon farming, fishing, and the harvest of longleaf yellow pine and cypress for lumber. The lower portion of the Calcasieu Estuary, which is largely rural, has maintained an economy supported by these natural resources. Petrochemical refining and production, however, has driven the economy of Calcasieu Parish in more recent years. The first natural gas field was discovered in Louisiana in 1823 at a depth of 400 feet, marking the first exploitation of naturally existing chemical compounds within the region. In 1869, the first sulphur mine in the U.S. was constructed just north of the Calcasieu Estuary, ending a monopoly held by Sicily, Italy. The City of Sulphur was created around the mines and named for its product.

In the mid-1920s, the Calcasieu Ship Channel (CSC) was dredged from Lake Charles to the Gulf to establish a deep-water port and enhance industrial development in and around Lake Charles. This action resulted in the creation of the Port of Lake Charles in 1926. The discovery and development of the oil and gas reserves of coastal Louisiana in the early twentieth century led to the siting and growth of many petroleum refineries and chemical production facilities along the Calcasieu River. As many as 30 major corporations have facilities located within the upper estuary, including those of CITGO Petroleum Corporation, Occidental Chemical Corporation and PPG Industries, Inc. These facilities produce a wide range of industrial and commercial products, and contribute significantly to the local and national economies as sources for a variety of fuels produced for local and national markets. The chemical and refining industries and the jobs they support have remained a major economic contributor for the region for several decades. The Port of Lake Charles is now one of Louisiana's 6 deep-draft ports and was ranked the 11th busiest port in the nation by tonnage in 2019 (USACE 2021). The USACE maintains the CSC to support continued shipping.

Recreational and commercial fishing occur throughout the estuary and have influenced the cultural history and economy of both Calcasieu and Cameron Parishes. Species fished include blue crab, red drum, black drum, spotted sea trout, southern flounder, Atlantic croaker, striped mullet, sheepshead, and sea catfish. The estuary is a popular destination for recreational fishing, with red and black drum, spotted seatrout, sheepshead, and flounder being the most commonly harvested species. Commercially, large numbers of blue crab are harvested in the estuary, including in the surrounding salt marshes. White shrimp and brown shrimp are also economically important species found in the system. These human activities are dependent upon the condition of the coastal and marine habitats that are essential in the life cycles of these resources. Other recreational activities, such as swimming, water skiing, wildlife viewing, and boating, also occur in the estuary. These activities do occur in the vicinity of the Site but are most prevalent in the lower portion of the estuary.

The lower portion of the estuary, from Moss Lake south to the Gulf, is located within Cameron Parish. Cameron Parish is primarily rural, supporting some small communities, agricultural operations (cattle grazing), and habitat utilized by numerous species of fish and wildlife. It is primarily undeveloped, and retains much of the early historical cultural and human uses including farming, hunting, and fishing. Small rural communities have been established, mainly along the coast, since most of the land within the area is marsh/wetland. A large portion of Cameron Parish is included within two designated National Wildlife Refuges - Sabine NWR and Cameron Prairie NWR. Both of these Refuges, as well as surrounding marshes, constitute important habitat for resident and migratory fish and wildlife. Thus, human uses of the lower estuary are largely based upon these natural resources. Both public and commercial interests throughout the estuary benefit from the abundance of organisms supported by this natural environment.

3.7 THREATENED AND ENDANGERED SPECIES

The Endangered Species Act (ESA; 16 U.S.C. §§ 1531–1544) was established to protect species vulnerable to extinction, as well as their environments. Marine organisms are under the jurisdiction of the NOAA Fisheries, while USFWS manages protection of federally listed threatened and endangered terrestrial and freshwater organisms. The ESA defines "endangered"

as a species in danger of extinction in all or a significant portion of its range. "Threatened" is defined as a species that is likely to become endangered in the foreseeable future. Section 7(a)(2) of the ESA (16 U.S.C. § 1536(a)(2)) as amended, requires:

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

All federally listed threatened and endangered species that have potential habitat or known occurrence in the Action Area are described in further detail below. The Action Area is defined as all areas that may be affected directly or indirectly by the Federal action (i.e., implementation of the Preferred Alternative). It includes not only the immediate area involved in the proposed action but encompasses the geographic extent of environmental changes (i.e., the physical, chemical, and biotic effects) that would result directly and indirectly from the action. It is typically larger than the area directly affected by the Proposed Action (i.e., Preferred Alternative) itself and is intended to include species or critical habitat that may be present in the entire potentially affected area. The LDWF's Wildlife Diversity Program also lists species that are of special concern to the state.

Table 3.3 provides a list of federal and state recognized endangered or threatened species known to occur in Calcasieu and Cameron Parishes. As of July 29, 2022, the published list of threatened and endangered species for the State of Louisiana includes 21 animal and three plant species (USFWS 2022a). The following 10 threatened and endangered animal species are potentially found in Calcasieu and Cameron Parishes: red-cockaded woodpecker, red knot, piping plover, eastern black rail, whooping crane, hawksbill sea turtle, Kemp's (Atlantic) ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, and West Indian manatee. Designated critical habitat for West Indian manatee, piping plover, red knot, whooping crane, hawksbill sea turtle, Kemp's (Atlantic) ridley sea turtle, leatherback sea turtle and loggerhead sea turtle also occur within these parishes (USFWS 2022b).

Table 3.3. Federal and State threatened and endangered species and their critical habitats within Calcasieu and Cameron Parishes, Louisiana.

Species[1]	Critical Habitat (CH)	Federal Status	State Status
Mammals			
West Indian Manatee (Trichechus manatus)	Yes, in Cameron and Calcasieu Parish	Threatened	S1N[3]
Birds			
Piping Plover (Charadrius melodus)	Yes, in Cameron and Calcasieu Parish	Threatened	S2N[4]
Red-Cockaded Woodpecker (Dryobates borealis)		Endangered	S2[5]

Red Knot (Calidris canutus rufa)	Yes, in Cameron and Calcasieu Parish	Threatened	S2N
Eastern Black Rail (Laterallus jamaicensis ssp.)	None in Louisiana	Threatened	S2N/S1B[6]
Whooping Crane (Grus americana)	Yes, in Cameron and Calcasieu Parish	Endangered	
Reptiles			
Hawksbill sea turtle (Eretmochelys imbricata)	Yes, in Cameron Parish	Endangered[2]	SZ[7]
Kemp's Ridley sea turtle (Lepidochelys kempii)	Yes, in Cameron Parish	Endangered[2]	S1B/S3N[8]
Leatherback sea turtle (Dermochelys coriacea)	Yes, in Cameron Parish	Endangered[2]	SZ
Loggerhead sea turtle (Caretta caretta)	Yes, in Cameron Parish	Threatened[2]	S1B/S3N
Fish			
Smalltooth Sawfish (Pristis pectinata)	None in Louisiana	Endangered[2]	S1
Plants			
American Chaffseed (Schwalbea americana)	None in Louisiana	Endangered	S1

[1] Current federally listed species lists for Calcasieu and Cameron Parishes are at: https://www.fws.gov/southeast/pdf/fact-sheet/louisiana-ecological-services-field-office-t-and-e-species.pdf.
[2] The United States Fish and Wildlife Service and the National Marine Fisheries Service share consultation authority for these species.
[3] S1N = Critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation; the occurrence of nonbreeding individuals.
[4] S2N = Imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation; the occurrence of nonbreeding individuals.
[5] S2= Imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation.
[6] S1B = Critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation; the occurrence of breeding individuals.
[7] SZ = Transient species in which no specific consistent area of occurrence is identifiable.
[8] S3N = Rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations); the occurrence of nonbreeding individuals.

3.8 ESSENTIAL FISH HABITAT

Commercial and recreational fisheries resources in the federal waters of the Gulf are managed by the Gulf Fishery Management Council (GMFMC) and NOAA Fisheries under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The GMFMC and NOAA Fisheries have identified waters and substrate necessary to fish for spawning, breeding, feeding, and growing to maturity as Essential Fish Habitat (EFH). EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." This definition extends to habitat specific to an individual species or group of species; whichever is appropriate within each Fishery Management Plan.

MSA also authorizes the designation of Habitat Areas of Particular Concern (HAPC) for marine fisheries. These areas are subsets of EFH that are rare, susceptible to human degradation, ecologically important or located in an ecologically stressed area. Any Federal agency that proposes any action that potentially affects or disturbs any EFH must consult with the Secretary of Commerce and Fishery Management Council authority per the MSA, as amended.

Virtually the entire northern coast of the Gulf to a depth of about 600 ft (183 m) has been identified as EFH for at least one species. The Calcasieu River is located in Eco-Region 4, where EFH has been designated in the estuarine water bottoms and emergent marsh habitats for brown shrimp, white shrimp and red drum.

Table 3.4. Essential Fish Habitat managed species that may occur in the nearshore restoration project areas.

Species	Life Stage	Essential Fish Habitat
Brown shrimp (Crangon crangon)	post-larval/ juvenile	marsh edge, submerged aquatic vegetation (SAV), tidal creeks, inner marsh
	Subadult	mud bottoms, marsh edge
White shrimp (Litopenaeus setiferus)	post-larval/ juvenile, subadult	marsh edge, SAV, marsh ponds, inner marsh, oyster reefs
Red drum (Sciaenops ocellatus)	post-larval/ juvenile	SAV, estuarine mud bottoms, marsh/water interface
	Subadult	Mud bottoms, oyster reefs
	Adult	Gulf of Mexico and estuarine mud bottoms, oyster reefs

3.9 ENVIRONMENTAL JUSTICE

Executive Order (E.O.) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, and the Department of Defense's Strategy on Environmental Justice of 1995 direct federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental impacts of federal projects on minority and low-income populations, and Tribal Nations. The USEPA defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice efforts focus on improving

the environment in communities, specifically minority and low-income communities, and addressing disproportionate adverse environmental impacts that may exist in those communities. Impacts on minority and low-income populations are considered disproportionately high and adverse under E.O. 12898 if they would "significantly … and adversely" affect a low-income or minority population and would "appreciably exceed or [be] likely to appreciably exceed" impacts on the general population or another appropriate comparison group (CEQ 1997). These impacts are described in Section 4, Environmental Consequences below.

Consistent with E.O. 12898, this section identifies low-income and minority populations within the potential restoration project areas in Calcasieu and Cameron Parishes based on the most recent socioeconomic statistics currently available from the U.S. Census Bureau's American Community Survey (ACS) 5-year estimates from 2015 to 2019 (https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/). Table 3.5 provides socioeconomic data on Calcasieu and Cameron Parishes. Calcasieu Parish has a minority population of approximately 30%, which is greater than the overall United States proportion (approximately 21%), while Cameron Parish has a minority population of approximately 7%. The population living below the poverty level for Calcasieu Parish and Cameron Parish is approximately 19% and 14%, respectively.

Table 3.5. Socioeconomic Data as of July 1, 2019 (US Census Bureau n.d.); https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/.).

Data	Calcasieu Parish	Cameron Parish
Population	203,436	6,973
Population Density (per mi^2)	181.2	5.3
Median Household Income (in 2019 dollars) 2015-2019	$51,148	$53,423
Population Living below Poverty Line*	18.9%	13.7%
Age 65 or Younger with a Disability (2015-2019)	10.9%	7.8%
Age 65 or Younger Living without Health Insurance	9.6%	10.2%
Race*		
White	70.1%	93.2%
Hispanic or Latino	4.1%	4.2%
Black or African American	25.8%	4.0%
Asian	1.4%	0.4%
American Indian and Alaska Native	0.6%	0.7%
Native Hawaiian and other Pacific Islander	0.1%	0.1%
Two or More Races	2.1%	1.7%

*Estimates are not comparable to other geographic levels due to methodology difference that may exist between different data sources. Minority populations comprise non-white populations, including Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, and other races, as described by U.S. Census Bureau.

The USEPA EJSCREEN: Environmental Justice Screening and Mapping Tool (Version 2.0) (https://www.epa.gov/ejscreen) was used to identify low-income and minority populations at the Census Block scale. The hazardous releases and resulting injury in the Calcasieu River Basin occurred across multiple Census Blocks. Census Block Groups west of the Calcasieu include 220190032001 (population 1,840) and 220190018012 (population 1,885), with low-income

populations of 26% and 10%, respectively. Minority groups represent 12% and 2% of the population in these blocks, respectively. Census Block Groups east of the Calcasieu River include 220190019012 (population 2,301), with a low-income population of 15% and a minority population of 5%. The affected environment for the proposed Sabine NWR marsh terrace field project includes Census Block Group 220239701001 (population 248), where 0% of the population is low-income and 49% of the population is minority. The proposed riparian mitigation bank credit purchase project is located within Census Block Group 220190017004 (population 2,124), which has a low-income population of 29% and a minority population of 37%.

4 INJURY AND SERVICE LOSS EVALUATION

4.1 SCOPE OF INJURY ASSESSMENT

The Trustees used data collected within the Bayou d'Inde Area of Concern (AOC) to evaluate injury, loss or destruction of natural resources and resource services caused by the release of hazardous substances from RP facilities at the Site. Trustee investigations found a variety of chemicals of potential concern (COPCs) within the AOC, including metals, mercury, PAHs, PCBs, organochlorine pesticides, semi-volatile organic compounds, and polychlorinated dibenzo-*p*-dioxins/dibenzofurans (USEPA 2003).

4.2 EVALUATION OF INJURY TO AQUATIC RESOURCES

Habitat provides ecological services, such as forage and shelter, to fish, wildlife and people that use it. Ecological services can be mapped, modeled, and valued using a multitude of methods. The Trustees evaluated injuries to natural resources within the Bayou d'Inde AOC by quantifying ecological service losses (ESLs) to four receptor groups using the area: invertebrates, fish, birds, and mammals by quantifying loss of habitat services based on the toxicity of COPCs within the AOC (i.e., habitat more toxic to receptors, whether it be through environmental media or forage, would provide reduced services; Sinclair et al. 2016.). Three types of data were used to evaluate injuries to these groups, including whole-sediment chemistry, invertebrate-tissue chemistry, and fish-tissue chemistry. Benthic invertebrate community ESLs were evaluated using whole-sediment chemistry data. Fish ESLs were estimated using fish-tissue chemistry data. Injuries to aquatic-dependent birds and mammals were quantified using fish-tissue chemistry, invertebrate-tissue chemistry, and whole-sediment chemistry data. Following is a description of the evaluation for each ecological receptor group the Trustees assessed. The injury quantification results presented in the following sections are from Sinclair et al. 2016.

4.2.1 Benthic Invertebrates

Estimates of ESLs to benthic invertebrates in the AOC are based on the relationship between mean probable effect concentration-quotient (PEC-Q)[9] and survival of the amphipod, *Hyalella azteca*, from 28-day exposures to sediments from the estuary. To maintain consistency with previous assessments of sediment injury and an agreement with the Settling Defendants on preliminary remediation goals (PRGs; MacDonald et al. 2003; MacDonald and Ingersoll 2004) for the Site, the Trustees applied an injury threshold for mean PEC-Q of 0.33, based on the geometric mean of the indeterminate risk and high risk PRGs to estimate ESLs associated with natural resource injuries in the AOC. This injury threshold was used to determine if injuries had occurred in both aquatic and riparian (i.e., floodplain) habitats. Using this approach, the Trustees quantified injury using the following equation:

[9] A probable effect concentration-quotient greater than 1 indicates toxicological risk from exposure. Mean Probable Effects Concentration Quotient (PEC-Q) was calculated using the procedure that was established by USEPA (2000).

$$\% \, Injury = 100 - \left[\frac{115}{\left(1 + \left(\frac{Mean\ PEC - Q}{1.05}\right)^{0.626}\right)} \right]$$

The Trustees calculated ESLs to benthic invertebrates for each sub-reach (a smaller portion of the total reach) using the equal-area approach, in which the total area within each sub-reach is divided by the number of samples within that sub-reach to determine the average acreage represented by each sample. Sample-specific injury estimates are then determined by calculating the percent injury using the above equation for each sample. All sediment chemistry samples from open water and wetland habitats within a reach were used to determine injury to benthic invertebrates. However, the Trustees recognize differences in relative productivity between these habitat types, so determined injury separately for each to facilitate scaling of overall injury estimates. The results of this assessment indicate that contaminant concentrations in Bayou d'Inde sediments were sufficient to cause a 12.7% reduction in benthic services in these habitats.

4.2.2 Fish

The Trustees used estimates of the toxicity of mercury, PCBs, dioxins and furans to fish within various reaches within the AOC to estimate ESLs to fish. To do this, the Trustees divided the AOC into reaches and collected fish samples from each reach with which to compare to toxicological thresholds. Average fish concentrations in each reach above toxicological thresholds indicated injury to fish in that reach. Injury was quantified for mercury using the injury threshold of 0.25 mg/kg wet weight (corresponding to a 95% certainty that injury would be observed at that concentration). The residue-based mercury dose–response curve developed by Dillion et al. (2010) was also applied because it was assumed that fish survival is a sufficient endpoint for quantifying injury to fish.

Injury to fish exposed to PCBs was scaled using the injury model developed by Tillitt and Hinck (2015) using the injury threshold of 0.5 mg/kg PCBs wet weight in whole body fish. Injury to fish exposed to dioxins and furans was scaled using the injury model developed by MacDonald and Smorong (2008) using the injury threshold of 0.2 µg/kg wet weight in whole body fish. The results of this assessment indicated that the concentrations of mercury, PCBs, dioxins and furans in the tissues of fish collected from Bayou d'Inde were sufficient to cause a 2.66% reduction in ecological services provided to fish.

4.2.3 Aquatic-Dependent Birds

The Trustees used estimates of the toxicity of mercury, PCBs, dioxins and furans to aquatic-dependent birds in the AOC to estimate ESLs to birds. The Trustees used three feeding guilds as proxies for birds: piscivorous birds, carnivorous-wading birds, and sediment-probing birds. Belted kingfisher was selected as the focal species to represent piscivorous birds, great-blue heron for carnivorous-wading birds, and spotted sandpiper for sediment-probing birds. Exposure to the three bioaccumulative COPCs (i.e., mercury, PCBs, and 2,3,7,8-TCDD Toxic Equivalency Quotients (TEQs)) was estimated for each species using a food web-modeling approach. In this approach, COPC concentrations in dietary components (sediment, invertebrates and fish) are used in conjunction with daily intake rates (expressed as % invertebrates, % fish, and % sediment; see USEPA 1993), body weights, and foraging ranges to estimate average daily

exposure to each COPC. The Trustees used the average concentration of each COPC for each media in each reach (assuming a concentration of zero if data were missing for a COPC within a reach from a particular media type), and metrics derived from published literature for intake rates, body weights and foraging ranges. The average daily intake (ADI) for each species was then calculated according to the following equation:

$$ADI = \frac{(P_1 \times DFI \times C_1) + (P_2 \times DFI \times C_2) + (P_n \times DFI \times C_n)}{BW}$$

Where:
ADI = average daily intake of the focal species (mg/kg BW/day);
DFI = daily food intake rate of the focal species (kg/day);
P_n = proportion of diet from food type *n*;
Cn = concentration of COPC in food type *n* (mg/kg WW); and,
BW = body weight for the focal species (kg).

ADIs were then compared to toxicological thresholds for each focal species to determine injury. For substances with ADIs that exceeded the corresponding injury threshold, an injury-scaling matrix was applied to estimate percent injury for the reach. Ecological service losses (in acres) for each guild were estimated by multiplying the assigned percent injury for that guild by the acreage of aquatic habitat within the reach. The results of this assessment indicate that the concentrations in sediment, aquatic invertebrates and fish from Bayou d'Inde are sufficient, on average, to cause a 12.1% reduction in ecological services provided to avian receptors.

4.2.4 Aquatic-Dependent Mammals

Injuries to aquatic-dependent mammals were quantified for omnivorous mammals, with raccoon selected as the focal species. Raccoon exposure to the three bioaccumulative COPCs (i.e., mercury, PCBs, and 2,3,7,8-TCDD TEQs) was estimated using the food web-modeling approach described for aquatic-dependent birds (see Section 4.3) using metrics applicable to raccoons.

ADIs were then compared to toxicological thresholds for raccoons to determine injury. For substances with ADIs that exceeded the corresponding injury threshold, an injury-scaling matrix was applied to estimate percent injury for the reach. Ecological service losses (in acres) was estimated by multiplying the assigned percent injury by the acreage of aquatic habitat within the reach, with the COPC causing the greatest injury selected as the determinate driver of adverse effects. The results of this assessment indicate that the concentrations of COPCs in the sediment, aquatic invertebrates and fish from Bayou d'Inde are sufficient, on average, to cause a 2.16% reduction in ecological services provided to mammals.

4.2.5 Summary of Injuries to Aquatic Habitats

Overall, the AOC included approximately 959 acres of aquatic habitat and 284 acres of riparian habitat (Table 4.1; Figure 2.2). The Trustees used calculations described in Sections 4.2.1-4.2.4 to estimate how many of these acres were injured in the context of providing services to benthic invertebrates, fish, aquatic-dependent birds, and aquatic-dependent mammals. The trustees then used a simple habitat allocation model to integrate ESLs for the various receptor groups. As a first step, the available aquatic habitat was divided in two, with one-half allocated for the benthic

invertebrate productivity and one-half allocated for fish productivity. Given the 12.7% service loss to benthic invertebrates (see Section 4.2.1), benthic injured acres for the AOC were estimated at 60.9 acres, including 13.9 acres of open-water habitat and 47.0 acres of mudflat/wetland habitats.

Table 4.1. Summary of impacted aquatic habitat in the Bayou d'Inde Area of Concern (AOC).

	Aquatic Habitat Type (Acres)			0 - 4' Riparian Habitat (Acres)		
Reach	Open Water	Mudflat/ Wetland	Total Aquatic Acreage	Sampled Areas	Unsampled Areas	Total 0 - 4' Riparian
Upper Bayou d'Inde	26.36	49.17	75.53	59	33.58	92.58
Middle Bayou d'Inde	72.43	171.44	243.87	62.65	72.28	134.93
Lower Bayou d'Inde	101.47	538.02	639.49	15.07	41.66	56.73
Total AOC	200.26	758.63	958.89	136.72	147.52	284.24

Given the 2.66% service loss to fish (see Section 4.2.2), the trustees estimated 12.8 injured acres for the AOC, including 2.2 acres of open water habitat and 10.6 acres of mudflat/wetland habitats. Thus, the Trustees estimated an injury of 73.7 acres of aquatic benthic invertebrate and fish habitat, including 16.14 acres of open-water and 57.6 acres of mudflat/wetland habitats.

A total of 885.2 acres of intact habitat was estimated based on the results of the aquatic injury evaluation, which was determined by subtracting the combined benthic and fish ESLs (73.7 acres) from the total available aquatic habitat (958.89 acres). The Trustees allocated one-half of these acres (442 acres) to use by avian receptors and one-half to aquatic-dependent mammals. Given the 12.1% service loss to aquatic-dependent birds (see Section 4.2.3), avian injured acres for the AOC were estimated at 53.7 acres, including 7.1 acres of open-water habitat and 46.6 acres of mudflat/wetland habitats. Given the 2.16% service loss to aquatic-dependent mammals (see Section 4.2.4), mammalian injured acres for the AOC were estimated at 9.6 acres, including 5.2 acres of open-water habitat and 4.3 acres of mudflat/wetland habitats. Thus, the Trustees estimated an injury of 63.3 acres of aquatic-dependent bird and mammal habitat, including 12.4 acres of open-water habitat and 50.9 acres of mudflat/wetland habitats.

In total, the Trustees estimated that 137 acres of aquatic habitat services were lost (i.e., toxic to ecological receptors, injured at the 100% level) due to release of hazardous substances. Of this, 28.4 acres of open-water habitat services and 108.5 acres of mudflat/wetland habitats services were lost (Table 4.2).

Table 4.2. Summary of impacted aquatic habitat in the Bayou d'Inde Area of Concern (AOC) by injury category.

Injury Category	Open Water Habitat (acres)	Mudflat/wetland habitat (acres)	Total injured acres for the AOC
Benthic	13.9	47.0	60.9
Fish	2.2	10.6	12.8
Birds (avian)	7.1	46.6	53.7
Mammal (aquatic dependent)	5.2	4.3	9.6
Total	28.4	108.5	136.9

Open-water habitat is difficult to restore while vegetated wetland is a preferred restoration approach. Therefore, the estimates of injured acres for the open-water habitats were converted to vegetated wetland equivalents using a conversion factor of 0.4 (i.e., mudflat/wetland habitats were not adjusted; MacDonald et al. 2006). As a result, the estimated 137 injured acres resulted in annualized aggregate injured acres of 199.9 acres in vegetated wetland equivalents.

4.3 SUMMARY OF INJURIES TO RIPARIAN HABITATS

Overall, the AOC included a total of 657.6 acres of floodplain habitat (i.e., within the 0-8-foot strata above MSL). Of this total, about 137 acres are within the riparian soil sampling strata included in the 2014 sampling program (note: only soils located within the 0-4-foot elevation above MSL were sampled). The ESLs associated with lost productivity of soil invertebrates were estimated using the injury threshold for mean PEC-Q of 0.33 (MacDonald and Ingersoll 2004). Using the data on the concentrations of metals, PAHs, and PCBs in the soil samples, ESLs associated with exposure of soil invertebrates to these hazardous substances were estimated at 1.4 acres.

4.4 EVALUATION OF INJURIES TO RECREATIONAL USE AND RESOURCES

Bayou d'Inde and the Calcasieu Estuary have several concurrent fish consumption advisories (FCA) and primary contact recreation advisories issued by LDH, LDEQ, and LDWF. Each advisory is linked to a specific contaminant, was assigned at a certain date, and provides guidance to the consumption of fish and/or shellfish and avoidance of surface water and/or sediments for the purposes of protecting human health.

A "no fish consumption advisory" (FCA) was issued in January 1987 for Bayou d'Inde and other portions of Calcasieu Estuary (Prien Lake and Calcasieu River between buoy numbers 112 to 106). In 1989, LDH and LDEQ issued a "no consumption advisory for speckled trout and white trout" due to the presence of hexachlorobenzene (HCB) and hexochlorobutadiene (HCBD) in the Calcasieu Estuary. In 1992, an FCA for Bayou d'Inde was issued by LDH and LDEQ due to the detection of HCB, HCBD, and PCB in fish samples. The advisory stated that "consumption of fish and seafood should be limited to two meals per month." The current FCA for Bayou d'Inde, which includes the Calcasieu Estuary, was issued November 17, 2016 and states "do not eat catfish; do not eat crab fat; and limit consumption of other fish and shellfish to two meals per month." This advisory is in place due to polychlorobiphenyl (PCBs), dioxin, and furan levels found in fish tissue and crab fat from sampling efforts conducted from 2011-2015. A primary contact recreation advisory is also in place that states "no swimming, water sports, and contact with bottom sediments."

Although the advisories are assigned to a broad area extending beyond Bayou d'Inde, the three contaminants (PCBs, HCBD, and HCB) that triggered the advisories in 1987 originated in Bayou d'Inde. Of 10 different sites evaluated by the Trustees in Bayou d'Inde, the Upper Calcasieu and the Middle Calcasieu, these three contaminants originated only from one emitter located in Bayou d'Inde. Additionally, sediment samples show highest concentrations of all three contaminants in Bayou d'Inde, with the presence of advisory-linked contaminants decreasing as distance from the site increases. Fish tissue samples taken throughout the Calcasieu Estuary show that approximately 5% of seafood meat samples contain PCBs, with the highest concentrations coming from middle Bayou d'Inde (CH2MHILL 2011).

4.5 SUMMARY OF INJURY ASSESSMENT

Natural resources within the AOC have been exposed to a variety of COPCs, including metals, mercury, PAHs, PCBs, organochlorine pesticides, semi-volatile organic compounds, and polychlorinated dibenzo-p dioxins/dibenzofurans. Multiple lines of evidence demonstrate that surface-water resources (i.e., surface water and sediments), groundwater resources (i.e., pore water), geologic resources (i.e., soils), biological resources (i.e., benthic invertebrates, fish, birds, and mammals), and recreational resources have been injured as a result of exposure to these hazardous substances. The Trustees compiled, evaluated, and interpreted available data to support quantification of injury to natural resources. The results of this evaluation indicate that annualized ESLs for the two habitat types considered were 199.9 acres for aquatic habitat (expressed as vegetated wetland equivalents), and 1.4 acres for riparian habitat (expressed as forested riparian equivalents).

In addition, the presence of contamination in target recreational fish causes recreational anglers to modify their behavior to reduce potential human health impacts. Anglers may fish less often, may travel to alternate locations, may alter their angling behavior (e.g. catch and release fishing), or may stop fishing all together. (Jakus et al 1997; Breffle et al 1999).

5 RESTORATION PLANNING PROCESS

5.1 RESTORATION GOALS AND OBJECTIVES

The overall goal of restoration under CERCLA is to restore, rehabilitate, replace or acquire natural resources and their services equivalent to natural resources injured or lost as a result of releases of hazardous substances. In October 2018 the Trustees and RPs completed a settlement to address natural resource injuries. Through this Draft RP/EA, the Trustees propose alternatives to use settlement funds to address these injuries.

5.2 IDENTIFICATION OF RESTORATION ALTERNATIVES

CERCLA requires the Trustees develop a reasonable range of restoration alternatives before selecting their preferred alternative to restore, rehabilitate, replace or acquire natural resources and their services equivalent to natural resources injured or lost as a result of releases of hazardous substances. The Trustees consulted various local, state and federal restoration efforts (e.g., Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) activities; 2012 Louisiana Coastal Master Plan; USACE Southwest Louisiana Coastal Study, etc.) and solicited ideas from the public to identify potential restoration opportunities in the Calcasieu Estuary for use in screening for this RP/EA. Potential restoration alternatives were initially identified based on their ability to restore resources injured, lost, or destroyed due to releases of hazardous substances by the Settling Defendants at the Site. The Trustees then used the screening criteria outlined below to evaluate potential alternatives for use in this RP/EA. The Trustees will consider additional information submitted during the public comment period in development of a final RP/EA.

In accordance with the NRDAR regulations (43 C.F.R. § 11.82(d)), and satisfying NEPA's requirement to identify and evaluate a reasonable range of alternatives, the Trustees used the following criteria to identify and evaluate restoration alternatives and propose alternatives for implementation under this plan:

- Technical feasibility and the likelihood of success of each project alternative: The Trustees considered whether proposed restoration actions (alternatives or projects) are technically feasible and whether each alternative has a reasonable chance of successful completion in an acceptable time period. The Trustees also consider whether long-term maintenance of project features are likely to be necessary and feasible. For example, high rates of subsidence at a project site are considered a risk to long-term existence of constructed habitats. Likewise, alternatives that are susceptible to future degradation or loss through contaminant releases or erosion are considered less viable.
- The cost to carry out the alternative: The benefits of a project relative to its cost are a major factor in evaluating restoration alternatives under NRDAR. Factors that can affect and increase the costs of implementing restoration alternatives may include project timing, access to the restoration site (e.g., with heavy equipment), acquisition of state or federal permits, acquisition of the land needed to complete a project, the potential liability from project construction, and adequate monitoring to ensure that project success criteria are met.

- Potential for Additional Injury: Restoration actions should not result in additional significant losses of natural resources and should minimize the potential to affect surrounding resources during implementation. Projects with less potential to adversely impact surrounding resources are generally viewed more favorably. Compatibility of the project with the surrounding land use and potential conflicts with any endangered species are also considered.
- Adverse Effects to Public Health and Safety: Projects that would negatively affect public health or safety are not appropriate.
- Compliance with applicable federal, state, tribal laws and policies: The Trustees considered whether restoration alternatives comply with all applicable federal, state, and tribal laws and if there would be ongoing compliance that must be completed before the alternative can be implemented.

The evaluation of projects according to the criteria involves a balancing of interests in order to determine the best way to meet the restoration objective. The Trustees are able to prioritize these criteria and use additional criteria as appropriate. The Trustees approached restoration planning with the view that the injured natural resources/lost services are part of an integrated ecological system, and that the Calcasieu Estuary area represents the relevant geographical area for Site restoration actions (i.e., areas outside of this are considered less geographically relevant for restoration alternatives for this case). This helps to ensure the benefits of restoration actions are related, or have an appropriate nexus, to the natural resource injuries and losses at the Site. The Trustees also recognized the importance of public participation in the restoration planning process, as well as the acceptance of the projects by the community. Alternatives were considered more favorably if complementary with other community development plans/goals.

The Trustees used standard methodology to help scale benefits of potential restoration alternatives. Scaling alternatives helps identify how much restoration is owed the public to offset injuries at the Site. These methods estimate expected service gains by incorporating anticipated timing of projects (start date and project lifespan) and services provided by projects over time.

5.2.1 No Action Alternative

NEPA and the NRDAR regulations require the Trustees to evaluate the "No Action" alternative, which for compensatory restoration equates to "No Compensation." Under this alternative, the Trustees would take no action to create, restore, or enhance natural resource services to compensate for the resource losses attributed to the Site. The Trustees determined that natural resources or ecological resource services were lost due to injuries caused by releases of hazardous substances from nearby facilities to the Site. While the remedial activities conducted by the Settling Defendants addressed the actions needed to allow injured resources to recover, the remedial activities did not compensate the public for ecological and human use resource service losses. The Trustees and Settling Defendants therefore completed a settlement in 2018 to address natural resource injuries. Per this settlement, the Settling Defendants provided $7,954,954 to fund natural resource restoration actions. The No Action Alternative is therefore not an appropriate alternative in this case.

5.2.2 Preferred Restoration Alternatives

5.2.2.1 Sabine National Wildlife Refuge Marsh Terracing Project

The Sabine National Wildlife Refuge Marsh Terracing Project would use in-situ material to construct approximately 128,500 linear feet of earthen marsh terraces within Trapper Shack Lake and Rita Lake on Sabine National Wildlife Refuge (Sabine NWR) in southern Cameron Parish, approximately 24 miles south of Lake Charles, Louisiana (Figure 5.1). The primary goal of the project is to enhance approximately 760 acres of coastal marsh habitat used by benthic organisms, fish, birds and other wildlife species, similar to habitat injured at the Site, and would provide both biological and spatial connection to the affected resources. This project would be implemented through a partnership with Ducks Unlimited.

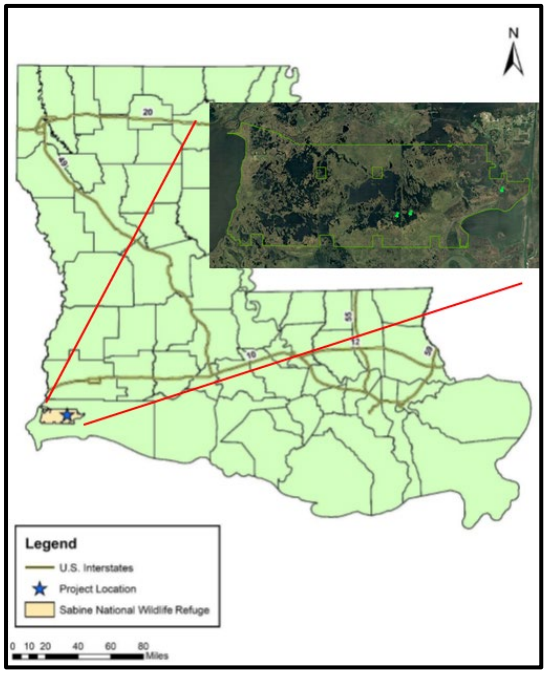

Figure 5.1 Sabine National Wildlife Refuge Marsh Terracing Project locations (inset, green pins), Sabine National Wildlife Refuge (inset, outlined in green), Cameron Parrish, Louisiana.

Earthen terraces are a coastal restoration technique that utilize on-site sediment to construct linear segments of emergent land in shallow open water that will either naturally revegetate or be planted with appropriate marsh vegetation. Once established, these features act to reduce wind induced wave fetch, which then lessens suspended sediment loads, and allows for a more conducive environment for submerged aquatic vegetation (SAV) to propagate. SAV habitat is sought after by many fish and wildlife species for the cover and forage it provides. In addition to these benefits, marsh terraces provide edge habitat and mudflat shoreline used by nekton, waterbirds, wading birds, shorebirds, waterfowl, and neotropical migrants for foraging and resting. By creating earthen terraces in previously shallow, open water, the habitat is enhanced to support more and diverse species. In addition to fish and wildlife habitat, people will benefit from this project through the ecosystem services it will provide, such as enhanced water quality, storm surge reduction, and carbon sequestration.

The terraces would be constructed to a target elevation of approximately +3.0 feet North American Vertical Datum of 1988 (NAVD 88) (with a one-year post construction settlement elevation of approximately +2.5 feet NAVD 88) and 1:5 side slopes. Final elevations would depend on the quality of the borrow material and results from the geotechnical survey. Terraces will be 250 feet long, with crowns 10 feet wide and 205 feet long. In order to construct terraces, a marsh buggy excavator will excavate a borrow area 25 feet away from each terrace base that will be no larger than 50 feet wide and 10 feet deep, on one or both sides of the terrace (depending on quality of borrow material). Approximately 5.4 cubic yards per linear foot of material will be used to construct the project features. The Trustees expect terraces in this area would have a 15-25 year life expectancy, depending on erosion and subsidence rates. Given

these assumptions, the Trustees anticipate this alternative would satisfy restoration required to compensate the public for aquatic injuries and services lost at the Site.

The proposed terraces are technically feasible and utilize proven techniques with established methods and documented results and can be implemented with minimal delay. Marsh terrace creation has been a coastal restoration technique used in Louisiana since the early 1990's and have been documented to persist on the landscape for at least 25 years (Steyer 1993; Good et al. 2005). The estimated cost to carry out the alternative is reasonable based on similar activities within the project area and would accomplish the desired habitat enhancement with the available funds. The project would use in situ material for terrace construction in otherwise open water habitat within an access-controlled area, all of which is expected to limit or prevent any adverse effects to public health and safety or additional injury to natural resources impacted at the Site. The project proposal is supported by USFWS management at Sabine NWR, and all activities would be closely coordinated with management of Sabine NWR and adhere to applicable federal and state laws, permits and policies.

Performance monitoring would be conducted for 5 years to provide an assessment of project progress and help guide corrective actions, if any, to meet the project's goals and objectives. The first year of performance monitoring would entail as-built surveys and vegetation surveys. As-built surveys will be performed after earthen terrace project features are complete. This will ensure proper construction and design specifications are met for quality assurance. Vegetation surveys will be conducted on the terraces by performing randomly selected line transects to measure species composition and percent cover. Vegetation surveys would then be conducted annually in years 2-5. Annual monitoring events will occur each year for 5 years during the growing season as outline in Table 5.1. If the performance criteria are satisfied during the monitoring period, then the Trustees are confident, based on observations of other similar projects in the area, that the project would be successful and no further monitoring would be required. Should one or more of the performance criteria not be met, corrective actions would be considered to remedy the situation.

Table 5.1. Proposed Sabine NWR Marsh Terracing Project success monitoring program.

Metric (include units)	**Difference to Recommended Methods and Protocols (if any)**	**Spatial extent of metric monitoring**	**Baseline/yr**	**Frequency/ Timing**	**Data Limitations/Considerations**
Percent Cover of biomass by species or cover type (% ranging from 0-100)	A 5% stratified random subset of constructed terraces will be selected for monitoring. Transects will be established perpendicular across earthen terrace with permanent 1 m^2 plots located on both sides of terrace banks and one plot on at terrace crown (3 plots per transect). A minimum	At each 1 m^2 monitoring plot.	Post construction	Annually /growing season	None

	of 25 transect with 3 plots on each transect will yield 75 monitoring plots total.				
Elevation	Will use benchmark method with RTK GPS unit taken at center of plot.	At each 1 m^2 monitoring plot.	Post construction	Growing season	None
Water Level (cm)	Water level data will be obtained using Coastwide Reference Monitoring System (CRMS) stations located in close proximity to project area and will be included in monitoring reports.	CRMS stations 2334, 0538, 0677, 0694, and 0685 may be referenced for this data.	Post construction	15-minute interval data/ available annually	None

5.2.2.2 Mitigation Bank Acreage Purchase

Figure 5.2 South Fork Coastal Mitigation Bank, Cameron and Calcasieu Parish, LA.

Mitigation banking is a system of credits and debits devised to ensure that ecological loss, typically resulting from impacts from development, is compensated by restoring and/or preserving a comparable ecosystem in a different area so there is no net loss to the environment. When a mitigation banker purchases an environmentally damaged site that they wish to regenerate, they work with regulatory agencies to approve plans for restoring, preserving, and monitoring bank acreage. Wetland or stream mitigation banks offer mitigation credits to offset losses of wetlands and streams, and are regulated and approved by the USACE and USEPA.

Established in 2009, Delta Land Services, LLC implements and sponsors mitigation bank and restoration sites throughout the southeastern United States. One of these sites, the South Fork Coastal Mitigation Bank (SFCMB), occurs approximately 13 miles southeast of Bayou d'Inde (Figure 5.2). The SFCMB was formally established through the agreement described by its 2016 Mitigation Bank Instrument (MBI) (Delta Land Services, LLC 2016). The MBI, an agreement among Delta Land Services, LLC; South Fork Holdings, LLC; USACE; USEPA; USFWS; LDWF; and the Louisiana Department of Natural Resources Office of Coastal Management, "sets forth guidelines and responsibilities for the establishment, use, operation, protection, monitoring and maintenance of the [mitigation] Bank". In short, the bank was established to provide USACE with opportunity to acquire ready-made mitigation credits to compensate for unavoidable impacts to waters of the United States as part of work authorized by the Department of the Army. However, the bank may also be used for other programs in accordance with the requirements and limitations set forth in the MBI in coordination with the USACE New Orleans District. The MBI was approved by USACE July 13, 2016.

South Fork Holdings, LLC, a subsidiary of Delta Land Services, LLC (DLS), purchased the SFCMB area in 2013 and 2014 for purposes of establishing a mitigation bank. At the time of purchase, the property consisted of farmland and rangeland utilized for rice and soybean production and cattle grazing. Habitat consisted of tallow-infested fresh-intermediate marsh and coastal prairie with man-made surface impoundments (Delta Land Services, LLC 2018). DLS completed preliminary restoration on the property in February 2016 to return it to BLH, coastal prairie, and fresh-intermediate marsh habitats characteristic of coastal Louisiana by restoring water levels and native vegetation. Restoration work was documented in an as-built report submitted by DLS to USACE July 2016. DLS also submitted post-restoration monitoring reports to USACE in 2017, 2019, and 2021 (i.e., years 1, 3 and 5 post construction). Habitat within the SFCMB now includes a mix of BLH, coastal prairie, and fresh-intermediate marsh. Observations of wildlife using the SFCMB include amphibians, arthropods and crustaceans typical of southwest Louisiana; mammals (e.g., bobcat (*Lynx rufus*), mink, and Nearctic river otter (*Lontra Canadensis*)); and 41 species of birds (e.g., waterfowl, migratory songbirds, whooping crane (*Grus americana*)) (Delta Land Services, LLC 2021). The SFCMB has a perpetual conservation servitude over the property in accordance with the Louisiana Conservation Servitude Act La. R.S. 9:1271 et seq., and 33 C.F.R. § 332.8(t), controlling prohibited uses consistent with protecting restoration into perpetuity. US Land Conservancy holds the conservation servitude.

The Trustees propose to purchase 30 - 40 acres within the SFCMB to partially compensate the public for injuries to riparian habitats at the Site. Habitat acquisition at the SFCMB is currently valued at $25K/acre. Perpetual protection of this habitat would satisfy restoration required to compensate the public for riparian habitat injuries lost at the Site, as well as provide services to fish and wildlife likewise injured. Acquisition of credits by the Trustees would include permanent protection, long-term monitoring, associated fees, financial assurances, etc. as described in the MBI and conservation servitude.

The proposed mitigation bank purchase can be implemented with minimal delay: the Trustees have coordinated potential purchase of SFCMB acreage with the USACE New Orleans District, who is supportive of the proposal. South Fork Holdings, LLC would continue to be the landowner. DLS retains partial interest in the bank, manages the bank property, monitors the bank, and handles all marketing and credit sale transactions. The estimated cost of acquiring restored habitat within the SFCMB is reasonable compared to similar activities that would otherwise need to be conducted and protected by the Trustees into perpetuity. Long-term protection of restored habitat within the SFCMB would not cause adverse effects to public health and safety or additional injury to natural resources impacted at the Site.

5.2.2.3 Recreational Fishing Enhancements

The Trustees propose using settlement funds to restore for lost recreational fishing opportunities by creating or enhancing infrastructure, access, and use opportunities. The Trustees have determined that these types of recreational use projects are consistent with the evaluation criteria described in Section 5.2; however, because specific projects have not yet been identified, they are not ripe for NEPA analyses in this Draft RP/EA. While the Trustees have not identified a specific restoration project to address this injury at this time, the Trustees are actively engaged in discussing potential opportunities with communities and local and State entities throughout the

affected area. Additionally, the Trustees are monitoring other efforts, such as restoration being conducted by the Deepwater Horizon (DWH) NRDA program to be best positioned to select an effective restoration project. The Trustees will give notice and an opportunity to comment to the public when a suitable project or projects are identified and the appropriate project-specific environmental analysis has been completed.

5.2.3 Non-preferred Alternatives

To address injuries to aquatic resources, the Trustees considered a number of marsh habitat restoration options in the Calcasieu/Sabine Basin. The Trustees further evaluated two alternatives in particular, chenier ridge restoration and marsh creation using dredged material, but for reasons articulated below, ultimately eliminated them from further consideration in this Draft RP/EA.

5.2.3.1 Chenier ridge restoration

The Louisiana Chenier Plain consists of two hydrologic sub-basins extending from the western bank of the Freshwater Bayou Canal to the Louisiana-Texas border. The chenier plain is characterized by marsh segmented by long, narrow sand and shell ridges parallel to the coast. The name "chenier" is derived from the French word "chêne", meaning oak tree, describing the ridges in southwest Louisiana generally dominated by oaks. The habitat and function of a chenier ridge is similar to that of a riparian corridor along a bayou or river. As such, coastal chenier ridges provide comparable habitat to Bayou d'Inde riparian habitat within the Calcasieu River floodplain, including foraging & roosting habitat for trans-Gulf migrants, nesting & roosting habitat for resident & migratory herons, egrets, and songbirds, and foraging & denning habitat for mammals, reptiles, and amphibians. Trustee activities to restore this habitat could include:

- project planning, engineering & design, including negotiation of conservation easement(s) to restore and protect habitat;
- acquisition of fee title or conservation easements to facilitate restoration;
- placement of in-situ material at an elevation of +5 ft NAVD88 to help enhance degraded ridges;
- enhancement of forested wetlands through removal of invasive vegetation (e.g., Chinese tallow [*Triadica sebifera*]) and planting native chenier tree and shrub species along ridges (LRRPP 2007); and
- fencing to exclude deer and cattle herbivory to protect habitat integrity and new plantings.

The intent of these activities would be to reforest denuded cheniers, restoring their function as critical features of wildlife habitat.

As part of their effort to scale benefits of potential chenier ridge restoration activities, the Trustees used inputs gathered from:

- the Louisiana Coastal Master Plan;
- the Louisiana Regional Restoration Planning Program Final Programmatic Environmental Impact Statement (LRRPP 2007);
- Southwest Coastal Louisiana Revised Integrated Draft Feasibility Report and Environmental Impact Statement (USACE 2015); and
- additional productivity information on bottomland hardwood forested habitats gathered from readily available literature.

Given our cost/benefit analysis of these activities, specifically the high cost of implementation, the Trustees believe the combination of preferred alternatives is more likely to provide the benefits needed to fully compensate the public for injuries to aquatic resources resulting from the hazardous waste release.

5.2.3.2 Marsh Creation – Beneficial Use of Dredged Material

As described in Chapter 2, marsh has been converting to open water in the Calcasieu River due to several factors. Use of dredge material to recreate coastal marsh provides aquatic resource benefits applicable to restoration from injuries at the Site. There are two primary sources of dredge material for marsh restoration in southwest Louisiana: offshore sources and material from the Calcasieu Ship Channel (CSC). Because offshore sources of sediment would require long pump distances, the cost of which would exceed funds available for restoration, the Trustees did not further evaluate offshore sediment sources. The Trustees did, however, review potential marsh restoration locations that would use material from the CSC and thus fit within available budgets. Based on these criteria, the Trustees identified and considered a 90-acre marsh restoration project that would create 63 acres marsh and nourish an additional 27 acres. The project is located in the Calcasieu/Sabine Basin, east of Sabine NWR, east of Highway LA 27 and mile 9 of the CSC (Figure 5.3). The project area encompasses primarily broken marsh and shallow open water. The source of material for the marsh creation and nourishment project would come from the lower CSC as part of USACE channel maintenance dredging. Material removed from the CSC would be directed to the target area to fit design criteria to meet the project goals. The Trustees would fund any additional costs incurred by USACE to direct dredge to the target area (i.e., beyond the otherwise least costly dredged material disposal or placement alternative (or alternatives) USACE would implement consistent with sound engineering practices and meets all federal environmental requirements). Project construction would ultimately involve marsh creation and nourishment by hydraulically dredging and transporting approximately 543,896 cubic yards of sediment from the CSC and placing the material into temporarily confined or semi-confined areas shown in Figure 5.3 within earthen containment dikes. The dredged slurry would be placed to a constructed fill elevation above the inundation range. The dikes would be gapped or degraded following filling to allow drainage and establish tidal functions. The fill would then settle into the intertidal range over the 20-year design life. Raising the marsh elevation with dredged sediment so that the marsh can support healthy marsh vegetation would alleviate land loss for the twenty-year project design life. The USACE would bid and construct the project as part of their maintenance dredging event for the lower CSC.

The project is technically feasible, utilizes proven techniques with established methods and documented results, and would provide similar and complimentary services as those injured during the hazardous waste release. However, the Trustees believe the combination of preferred alternatives has a greater likelihood of success of providing the benefits needed to fully compensate the public for injuries to aquatic resources resulting from the hazardous waste release.

Figure 5.3 Marsh creation area evaluated as a potential restoration alternative, Calcasieu Parish, LA.

6 ENVIRONMENTAL CONSEQUENCES

The environmental consequences analyses below applies only to the Sabine NWR Terracing Project alternative and the no action alternative. The Riparian Mitigation Bank Credit Purchase alternative does not include Trustee-implemented active construction or other physical contact with the environment, as the mitigation bank has already been constructed and is now a fully functioning wetland. Because restoration banks are generally developed prospectively by private entities and independent of any particular legal settlement, in this case the federal action under NEPA is only the credit purchase by the Trustees, which is a simple financial transaction. In the case of purchase of credits developed through a restoration bank, typically by a non-federal entity, the effects on the environment are independent of the federal action, and no further environmental impacts would be expected. This determination is consistent with the findings in the NOAA Restoration Center Programmatic EIS, which analyzes the impacts from various conservation transactions, including restoration and conservation bank credit transactions (NOAA 2015).

A full environmental review was premature for the non-preferred projects, as they are not yet ready for NEPA analyses for various reasons (e.g., project details and feasibility unknown at this time). The Trustees may consider these projects for implementation in the event that the preferred projects are no longer available or are infeasible due to unforeseen circumstances. Should the Trustees consider these projects for implementation in the future, additional review may be required as project-specific details become available, in which case any subsequent NEPA analyses needed would tier from this RP/EA.

6.1 SOUND, VISUAL AND AIR QUALITY

No Action

There would be no construction activities associated with no action and as such, there would be no adverse impacts to sound, visual and air quality conditions from construction activities. Similarly, there would be no noise above the ambient levels because there would be no construction activities. The historically functional marsh within Sabine NWR would continue to be dominated by open water, marsh would continue to erode, and habitat would not be restored, possibly diminishing the aesthetics of a natural environment. Air quality conditions would remain as they are.

Preferred Alternative

Machinery and equipment used during construction of the Sabine NWR terrace project (e.g., heavy equipment operations such as mechanical dredging and contouring the terraces) could generate sound and air emissions that could temporarily disturb fish, wildlife and humans near the construction activity. Adverse impacts on mobile species (e.g., fish, birds and mammals) are expected to be minor, consisting of short-term displacement as they volitionally move away from the restoration activity. Air emissions from equipment and/or machinery may temporarily increase emissions in the immediate area, but such effects would be similar to emissions of nearby vehicle or boat traffic and would not result in an overall increase in air emissions. Impacts from the combustion of fossil fuels will nonetheless include some release of greenhouse gases (i.e., carbon dioxide and nitrogen oxides), volatile organic compounds, ozone, smoke,

increased particulate matter, and other pollutants. However, the Project area is located in Air Quality Control Regions that are in attainment with National Ambient Air Quality Standards and the increase in emissions from the vehicles, machinery, and construction equipment will be minimal and are not expected to cause exceedances of these standards. Additionally, the Sabine NWR terrace project is in a rural area, not immediately adjacent to residential or commercial property; therefore, the temporary sound, visual, and air quality impacts will have limited impacts on the surrounding human population. There may be temporary and localized minor adverse visual impacts during implementation of the selected action associated with construction activities (e.g., heavy equipment operating). Once the terraces are completed, users of the area would reasonably be expected to perceive the project areas as having improved aesthetics; therefore, long-term and minor beneficial impacts to visual resources can be expected.

6.2 VEGETATION, WATER AND SEDIMENT QUALITY

No Action

Under the No Action Alternative, the hydrology of the Sabine NWR terrace field project area would reasonably be expected to remain unchanged and marsh erosion would continue. However, as marsh loss continues, the wave induced erosion would continue to increase as a result of increased wind fetch. This would reduce wetland vegetation through the conversion to open water and distribute eroded marsh as suspended sediment during larger wind driven events.

Preferred Alternative

Under the preferred alternative, short term impacts are anticipated to occur as a result of excavation and other activities associated with heavy machinery. These will likely be minor and temporary, with water and sediment quality expected to return to pre-construction conditions upon project completion. There is also the potential to disturb existing vegetation through trampling and marsh buggy activities, but any disturbed vegetation will likely become recolonized or re-established over time. Overall, hydrologic, vegetative and sediment conditions within the Sabine NWR terrace field project area would be beneficially impacted by the creation of marsh terraces. The open water areas through which water exchange now occurs would be compartmentalized via terraces, reducing wind fetch and marsh erosion, and providing a more conducive environment for SAV to propagate. Additionally, the terraces would be vegetated and could help retain suspended sediment to create additional marsh along the terrace edges over the life of the project. Therefore, the construction of the Sabine NWR terrace project is expected to enhance and provide long-term minor to moderate beneficial impacts on vegetation, water and sediment quality in the Project area.

6.3 THREATENED AND ENDANGERED SPECIES

No Action

The No Action Alternative would not involve any construction activities and as such, there would be no beneficial or adverse impacts to species listed as threatened or endangered under the Endangered Species Act (16 U.S.C. § 1531 *et seq*.).

Preferred Alternative

Gulf sturgeon is the only threatened fish species in the northern Gulf within Louisiana. Gulf sturgeon inhabit riverine and estuarine environments in the spring during breeding, and either move offshore or parallel to shore between adjacent estuary systems during winter months. The

Sabine NWR terrace field project is not in areas known to contain Gulf sturgeon and therefore the project would have no effect on Gulf sturgeon. The portions of Sabine NWR where the terrace field projects are located do not contain access or suitable nesting habitat for sea turtles (Green, Hawksbill, Kemp's Ridley, Leatherback and Loggerhead) and therefore there will be no effect to these listed species.

Piping plovers and red knots occur seasonally in coastal areas in Louisiana. Piping plover habitat includes intertidal portions of ocean beaches, wash over areas, mudflats, sand flats, algal flats, shoals, wrack lines, sparse vegetation, shorelines of coastal ponds, lagoons, ephemeral pools, and areas adjacent to salt marshes but not within the salt marsh. Red knot habitat includes intertidal marine habitats near coastal inlets, estuaries, and bays, or along resting formations. Piping plover or red knot wintering habitat do not occur or are sparse in the project area. Therefore, implementation of the Preferred Alternative is not expected to adversely affect these species.

6.4 ESSENTIAL FISH HABITAT, WETLANDS, SUBTIDAL AND INTERTIDAL FLATS, AND OYSTERS

No Action

EFH in the Calcasieu River and estuary is estuarine emergent wetlands, submerged aquatic vegetation, estuarine water column, and mud, sand, shell and rock substrates. Under the MSA, wetlands, subtidal and intertidal habitat in the project area are identified as EFH for postlarval/juvenile and subadult brown shrimp; postlarval/juvenile and subadult white shrimp; and postlarval/juvenile, subadult, and adult red drum. With no action, there would be no restoration that protects and enhances EFH, specifically wetlands, subtidal habitat and shell substrate. Because EFH within the Calcasieu River and estuary provides important production for EFH habitat and fisheries injured from the release at the Site, no action would not provide the necessary restoration needed for the respective fisheries.

Preferred Alternative

The implementation of the Sabine NWR terrace field project would have some short-term, minor adverse impacts to EFH, specifically mud bottoms and estuarine water column, associated with construction and increases in turbidity during the excavation of borrow sources and placement of dredge material for terrace creation. However, implementation of the project would have long-term positive impacts to marsh EFH by creating marsh edge habitat and potentially submerged aquatic vegetation between terraces. This will benefit subadult brown shrimp and post larval/juvenile red drum through an enhanced food web as marsh edge serves as a critical and highly productive transition zone between the emergent marsh vegetation and open water habitat.

6.5 FISHERIES

No Action

No action would maintain open water habitat and not create valuable terrace and marsh edge habitat. The Trustees do not anticipate any net ecological benefits associated with no action and there would be no increase in fisheries productivity needed to make the public whole from the releases of hazardous substances at or from the Site.

Preferred Alternative

The creation of healthy marsh habitat and other EFH associated with the implementation of the Sabine NWR terrace field project would provide a greater diversity of foraging, breeding, spawning, and cover habitat for a greater variety of adult and juvenile fish and shellfish species. The marsh would contribute nutrients and detritus that would be added to the existing food web, providing a positive benefit to local area fisheries. Therefore, long-term minor beneficial impacts to fisheries are expected. Mechanical dredging and placement of sediments associated with the construction of the marsh terraces would temporarily displace fish in the immediate project area but these adverse impacts are expected to be minor.

6.6 WILDLIFE

No Action

With no action, there would be a continued loss of wildlife habitat associated with marsh loss. The loss of this habitat (e.g. continued conversion of marsh to open water) would reasonably be expected to displace wildlife and reduce the associated food web. Potential wildlife species that would be negatively impacted over time due to the loss of marsh habitat include nutria, muskrat, mink, river otter, raccoon, American alligator, western cottonmouth, water snakes, speckled kingsnake, rat snake, and eastern mud turtle, bullfrog, southern leopard frog, and Gulf coast toad.

Preferred Alternative

Machinery and equipment used during construction of the Sabine NWR terrace field project would reasonably be expected to temporarily disturb wildlife near the construction activity. Adverse impacts on mobile species (e.g., birds, mammals) are expected to be minor, consisting of short-term displacement. The proposed Sabine NWR terrace field project is expected to provide both direct and indirect, long-term minor to moderate benefits to wildlife species that utilize the marsh and prey on benthic invertebrates and fisheries that will benefit from the increased edge habitat and fisheries production.

6.7 PUBLIC ACCESS AND RECREATION

No Action

Under this alternative, there would be no change in current public access and recreation. However, over time, no action is expected to reduce fisheries productivity, marsh edge habitat and productivity of various bird species that utilize Sabine NWR, which would reasonably diminish recreational fishing and hunting experiences through reduced catch/harvest rates. Additionally, continued degradation of the Sabine NWR would reduce use and access to fishing opportunities.

Preferred Alternative

The implementation of the Sabine NWR marsh terrace field project would improve recreational opportunities. Recreational activities taking place within the Sabine NWR include boating, hunting, fishing and natural and cultural study. The project area is an area of vital importance as a fishery nursery ground, and waterfowl wintering and hunting area. Recreational fishing is a popular recreational activity in Sabine NWR because of the access to water bodies, bayous, and marsh. Small game hunting is also popular due to abundance of habitat and the wide range of species available to the hunter. Implementation of the Preferred Alternatives would beneficially impact these recreational opportunities by enhancing the habitats that they utilize. There may be some adverse impacts to public access and recreation in the immediate project area during

construction; however, these impacts would be temporary and minor, and the adjacent areas would continue to afford recreational opportunities.

6.8 HISTORIC AND CULTURAL RESOURCES

No Action

No action would not result in impacts to historic and cultural resources, as ground-disturbing work that could impact such resources would not occur.

Preferred Alternative

Impacts to cultural or historic sites are not anticipated. The Trustees will consult with the State Historic Preservation Officer of Louisiana to ensure the proposed projects will have no adverse effect on cultural or historic sites.

6.9 ENVIRONMENTAL JUSTICE

No Action

Under this alternative, there would be no long-term beneficial impacts to the public, including minority and low-income populations, from improved habitat and recreational use opportunities. Additionally, the lack of meaningful recovery of injured natural resources could have some indirect, minor adverse impacts on the economic and social well-being of all residents within the area of the Calcasieu estuary.

Preferred Alternative

Restoration activities supported by the Trustees help to ensure the enhancement of environmental quality for all populations in the project area. The Trustees have determined that all proposed restoration activities would provide long-term minor beneficial impacts to the Environmental Justice communities described in Section 3.6 by improving the quality of the natural environment and ecosystem services, and providing additional recreational opportunities. None of the alternatives are expected to have a disproportionately high and adverse impact on minority or low-income populations in the area, including economically, socially, or in terms of conditions affecting their health.

6.10 CLIMATE AND CLIMATE RESILIENCY

No Action

No short-term impacts would be anticipated under the No Action Alternative. In the long term, local areas would remain or become increasingly vulnerable to the consequences of extreme weather events including flooding.

Preferred Alternative

The Sabine NWR marsh terrace project is expected to improve local resiliency to increased frequency of extreme weather events such as flooding associated with precipitation and storm surge (Barbier, 2014).

Minor short-term adverse direct effects on greenhouse gas (GHG) emissions are expected as a result of the implementation of the Sabine NWR marsh terrace project. Actions resulting in GHG emissions may include the use of heavy equipment for construction, transport of materials needed for construction, and other activities associated with pre- and post-implementation such

as monitoring and adaptive management. These activities have the potential to generate GHG emissions through the use of oil-based fuels and consumption of both renewable and nonrenewable resources. However, the amount of GHG emissions generated through this activity is not anticipated to be significant due to the limited number of restoration projects, extended construction time, and the use of best management practices as described above in the section on air quality.

Long-term minor beneficial impacts to factors affecting climate change may result from restoration projects that include natural recruitment or planting of vegetation with native species on the marsh terraces that would increase carbon storage capacity of soils and plant communities, contributing to carbon sequestration.

6.11 OTHER (E.G., ECONOMIC, LAND USE AND TRANSPORTATION)

No Action

Land use would not change at Sabine NWR. However, economic impacts associated with marsh erosion (land loss) would reasonably be expected to diminish fisheries productivity that could affect recreational fishing opportunities, as well as reduce waterfowl habitat that could reduce hunting opportunities.

Preferred Alternative

Implementation of the Preferred Alternative is not expected to adversely impact land use, transportation or economic values. None of the project activities would require private landowner access (e.g., easements) or necessitate land use changes or modifications.

Implementation of the Preferred Alternative would restore and enhance natural resource services, including recreational fishing and waterfowl hunting, which would be available into the future providing economic value. Healthy marshes and reefs serve as extremely valuable forage and nursery habitat for many of the important recreational and commercial species of finfish; thus, long-term minor beneficial impacts to the economy may be expected.

6.12 CUMULATIVE IMPACTS

Under NEPA, federal agencies are required to consider the cumulative effects of their proposed actions within the affected environment. Cumulative impacts are the collective result of the incremental impacts of an action that, when added to the impacts of other past, present, and reasonably foreseeable future actions, would affect the same resources, regardless of what agency or person undertakes those actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 C.F.R. § 1508.7). Although the impacts of individual actions taken separately might be minor, the impact of those same actions taken together may be significant for one or multiple resources.

A cumulative impacts analysis focuses on the resources rather than the planned action and considers impacts that take place on both spatial and temporal scales. On a spatial basis, impacts must be considered both within and outside the proposed project area. Time scales for a cumulative impacts analysis are generally longer than project-specific analysis of impacts.

The Trustees have reviewed potential past, present, and reasonably foreseeable actions to assess the potential for cumulative impacts. In this Draft RP/EA, the Trustees considered the potential cumulative impacts of both the No-Action Alternative and the Preferred Alternative in light of restoration planning efforts and opportunities in the region, including such programs as:

- USACE New Orleans District's Operations & Maintenance (O&M) Program (https://www.mvn.usace.army.mil/About/Offices/Operations/Beneficial-Use-of-Dredged-Material/);
- Louisiana Coastal Area Beneficial Use of Dredged Material (LCA BUDMAT) Program (https://www.mvn.usace.army.mil/Missions/Environmental/Louisiana-Coastal-Area/Beneficial-Use-of-Dredged-Material/);
- CPRA (https://coastal.la.gov/our-work/projects/);
- CWPPRA (https://www.lacoast.gov/new/Projects/Default.aspx);
- and other NRDA restoration efforts, including:
    - Deepwater Horizon Oil Spill (DWH) NRDA Louisiana Trustee Implementation Group (LA TIG) (https://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana)
    - Final Damage Assessment and Restoration Plan and Environmental Assessment for the 2006 Calcasieu River Oil Spill (NRDA Case File #LA2006_0621_0846)

No Action
No action would contribute to the cumulative loss of aquatic and terrestrial marsh habitat resources throughout coastal Louisiana. Although there are many restoration efforts underway throughout coastal Louisiana through various programs (USACE, CWPPRA, CPRA, DWH LATIG), no action would contribute to a degrading baseline, which would reasonably be expected to cause adverse impacts to aquatic and terrestrial resources. Relative to the magnitude of adverse ecological impacts that currently exist in the affected area, the adverse cumulative impacts of the No Action Alternative are not expected to be significant but would not make the public whole from the releases of hazardous substances at or from the Site.

Preferred Alternative
The preferred restoration actions taken together will be cumulative in the sense that creation and enhancement of aquatic and terrestrial resources will provide ecological services into the future. Because these restoration actions are intended to compensate the public for resource injuries caused by the releases of hazardous substances at or from the Site, their cumulative impacts, especially when considered with other past, present, and reasonably foreseeable restoration efforts in the area, are expected to be long-term, minor and beneficial. Based on the environmental analysis conducted herein, the Trustees do not anticipate any adverse cumulative impacts as a result of implementing the proposed restoration action. Cumulative project impacts would not be significant or occur at a regional scale.

6.13 PRELIMINARY FINDING OF NO SIGNIFICANT IMPACT

Based on the analysis of the available information presented in this document, the Trustees have preliminarily concluded that implementation of the preferred restoration actions, as proposed herein, would not significantly impact the quality of the human environment. All potential beneficial and adverse impacts have been considered in reaching this conclusion. Unless

information indicating the potential for significant impacts is revealed through the public review and comment process on this Draft RP/EA, an EIS will not be prepared for the proposed restoration action and the agencies will issue a FONSI. Issuance of a FONSI for the Final RP/EA would fulfill and conclude all requirements for compliance with NEPA by the Federal Trustees.

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