FINAL

DAMAGE ASSESSMENT AND RESTORATION PLAN

for 2014 Mid-Valley Pipeline Oil Spill

NRDA CASE FILE #LA2014 1013 1210

Prepared by:

Louisiana Oil Spill Coordinator's Office, Department of Public Safety
Louisiana Department of Natural Resources
Louisiana Department of Wildlife and Fisheries
Louisiana Department of Environmental Quality
Louisiana Coastal Protection and Restoration Authority

June 2022

(This page intentionally left blank)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

This document is a Final Damage Assessment and Restoration Plan (DARP) prepared for the October 13, 2014 unauthorized discharge of crude oil from the Mid-Valley Pipeline near Mooringsport, Caddo Parish, Louisiana (referred to herein as the "Incident"). At the time of the Incident, the pipeline was owned by Mid-Valley Pipeline Company ("Mid-Valley") and operated by Sunoco Pipeline L.P. ("Sunoco"). Approximately 4,500 barrels of crude oil were released into the surrounding area, including Miller Branch, Tete Bayou, and connecting waterways and wetlands within the Caddo Lake Watershed and the Red River drainage. Response operations to contain and remove the discharged oil commenced immediately and continued for several months. Natural resources within the area that provide services to the public were adversely impacted by the discharged oil and response actions including wildlife, mixed forest, bayhead swamp, and aquatic habitats.

This Final DARP is intended to inform members of the public about the natural resource injuries caused by the Incident, and the restoration actions selected by the Trustees to compensate the public for those injuries, all consistent with the Oil Pollution Act of 1990 (OPA) (33 U.S.C. 2701 *et seq*.), its implementing regulations (15 C.F.R. Part 990), the Louisiana Oil Spill Prevention and Response Act of 1991 (OSPRA) (La. R.S. 30:2451, *et seq*.), and its implementing regulations (LAC 43:XXIX). This document is part of the Natural Resource Damage Assessment (NRDA) process being performed pursuant to OPA and OSPRA by the Natural Resource Trustees (Trustees) for the Incident, which include the Louisiana Oil Spill Coordinator's Office, Department of Public Safety and Corrections (LOSCO); the Louisiana Department of Environmental Quality (LDEQ); the Louisiana Department of Natural Resources (LDNR); the Louisiana Department of Wildlife and Fisheries (LDWF); and the Louisiana Coastal Protection and Restoration Authority (CPRA) (collectively the "Trustees").

This Final DARP provides information on:

- the purpose and need for a restoration plan, the Incident, legal authorities, and NRDA process (Chapter 1);
- the physical, ecological, and cultural and human use environments found in the affected area (Chapter 2);
- the injury assessment procedures used by the Trustees as well as the nature, degree, and extent of injuries to natural resources and services resulting from the Incident (Chapter 3); and
- the potential restoration action considered by the Trustees and the Trustees' preferred restoration alternative (Chapter 4).

The goal of injury assessment under OPA and OSPRA is to determine the nature, degree, and extent of injuries, if any, to natural resources and their services in the affected environment to provide a technical basis for evaluating and scaling restoration actions. Based on information

collected and evaluated by the Trustees during the injury assessment, the Trustees determined that the Incident caused injuries to mixed forest, bayhead swamp, aquatic habitat, and wildlife, as summarized below in Table ES.1.

Table ES.1. Summary of injuries, case-specific resource category and Regional Restoration Planning Program (RRP Program) injured resource and service category, provided in discounted service acre years (DSAYs) for habitat and discounted turtle-years (DTYs) for the Incident.

Case-Specific Injured Resource Category (Degree of Injury)	**RRP Program Injured Resource and Service Category**	**Amount Injured (acres/counts)**	**Injury**
Mixed Forest (heavy)	Inland Upland Vegetation Inland Forested Wetland	11.6 (acres)	228.75 DSAYs
Mixed Forest (light)	Inland Upland Vegetation Inland Forested Wetland	65.7 (acres)	8.31 DSAYs
Bayhead Swamp (heavy)	Inland Forested Wetland	9.0 (acres)	15.92 DSAYs
Bayhead Swamp (light)	Inland Forested Wetland	16.9 (acres)	19.63 DSAYs
Aquatic (heavy)	Inland Beaches/Shorelines/ Streambeds	10.1 (acres)	35.70 DSAYs
Wildlife	Wildlife	49 turtles (direct kill and production foregone)	1,406.40 DTYs

The goal of restoration under OPA and OSPRA is to return injured natural resources and services to the conditions that existed prior to the incident and make the environment and public whole for interim losses. To accomplish this goal, the Trustees evaluated expected benefits of potential restoration actions to identify a preferred restoration alternative that would address natural resource injuries resulting from the Incident. As a result, the Trustees selected the implementation of the United States Fish and Wildlife Service – Natchitoches National Fish Hatchery Alligator Snapping Turtle Head-Start Project as one component of the preferred restoration alternative for this NRDA. Restoration action(s) for mixed forest, bayhead swamp and aquatic habitat were not proposed at this time, as the Trustees are still evaluating habitat restoration project(s) to address these injuries. When suitable projects are identified, the Trustees will conduct a restoration type selection screening to identify preferred restoration type(s) and fully describe and evaluate the potential restoration project(s) under OPA and OSPRA in a subsequent restoration plan that will be made available for public review and comment, as further explained in Chapter 4.

1 INTRODUCTION

1.1 Purpose and Need for a Restoration Plan

This Final Damage Assessment and Restoration Plan (DARP) is intended to inform members of the public about the natural resource injuries caused by the October 13, 2014 unauthorized discharge of crude oil from the Mid-Valley Pipeline near Mooringsport, Louisiana, as well as restoration alternatives the Trustees considered and selected for the purposes of compensating the public for those injuries. The purpose and need for the selected restoration alternative evaluated in this Final DARP is to restore natural resources injured by the Incident consistent with Oil Pollution Act of 1990 (OPA), (33 U.S.C. 2701 *et seq*.), its implementing regulations (15 C.F.R. Part 990), the Louisiana Oil Spill Prevention and Response Act of 1991 (OSPRA) (La. R.S. 30:2451, *et seq*.), and its implementing regulations (LAC 43:XXIX). This document is part of the Natural Resource Damage Assessment (NRDA) process being performed pursuant to OPA and OSPRA by the Trustees for the Incident, which include Louisiana Oil Spill Coordinator's Office, Department of Public Safety and Corrections (LOSCO); the Louisiana Department of Environmental Quality (LDEQ); the Louisiana Department of Natural Resources (LDNR); the Louisiana Department of Wildlife and Fisheries (LDWF); and the Louisiana Coastal Protection and Restoration Authority (CPRA).

1.2 Overview of the Incident

On October 13, 2014, the Trustees were notified of an unauthorized discharge of crude oil from the Mid-Valley Pipeline near Mooringsport, approximately 10 miles southeast of Caddo Lake, Caddo Parish, Louisiana. At the time of the Incident, the pipeline was owned by Mid-Valley and operated by Sunoco. Approximately 4,500 barrels of crude oil were released into the surrounding area, including Miller Branch, Tete Bayou, and connecting waterways and wetlands within the Caddo Lake Watershed and the Red River drainage as seen in Figure 1.1. Response operations to contain and remove the discharged oil commenced immediately and continued for several months. At the height of the response, approximately 400 personnel were on-scene assisting with the clean-up of spilled oil. Sunoco clean-up operations included, among others, hard and sorbent booming, use of skimmers, excavation, high pressure flushing, damming, various washing techniques, removal of oiled habitat, use of vacuum trucks, and habitat removal to create access roads. Natural resources within the area that provide services to the public were adversely impacted by the discharged oil and response actions resulting in injuries and mortality to a variety of wildlife, including amphibians, birds, fish, invertebrates, mammals, and reptiles. Mixed forest, bayhead swamp, and aquatic habitats and the services that those resources provide, among others, were also adversely impacted as a result of the discharged oil and response activities.

Figure 1.1 Incident location in Mooringsport, Caddo Parish, Louisiana

1.3 NRDA Authority

OPA and OSPRA are the principal federal and state statutes, respectively, authorizing federal and state agencies and tribal officials to act on behalf of the public to (1) assess damages for injuries to natural resources and services resulting from a discharge of oil or the substantial threat of a discharge and (2) develop and implement a plan for the restoration, rehabilitation, replacement, or acquisition of the equivalent of the injured resources. By letter dated March 27, 2017, and pursuant to 33 U.S.C. § 2706(b)(3) and 40 C.F.R. § 300.605, the Governor of Louisiana designated LOSCO, LDEQ, LDNR, LDWF, and CPRA to act on behalf of the public as Trustees under OPA. These same agencies serve as State Trustees under OSPRA according to La. R.S. 30:2451, *et seq.* and LAC 43:XXIX.

1.4 NRDA Process and the Louisiana Regional Restoration Planning Program

The NRDA process conducted pursuant to OPA and OSPRA and the corresponding regulations promulgated thereunder at 15 C.F.R. Part 990 and LAC 43:XXIX consists of three phases: (1) Preassessment; (2) Restoration Planning; and (3) Restoration Implementation. OPA authorizes federal, state, and tribal natural resource trustees to initiate a damage assessment, among other requirements, when natural resources may have been injured and/or natural resource services impaired as a result of discharges of oil. OPA regulations provide specific definitions for the following terms:

- "Injury" is "an observable or measurable adverse change in a natural resource or impairment of a natural resource service";
- "Natural resources" are "land, fish, wildlife, biota, air, 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"; and,
- "Natural resource services" are "functions performed by a natural resource for the benefit of another resource and/or the public."

During the Preassessment phase, the Trustees determined that legal jurisdiction existed to conduct a NRDA for this Incident, including: (1) one or more incidents had occurred; (2) the discharge was not from a public vessel; (3) the discharge was not from an onshore facility subject to the Trans-Alaska Pipeline Authority Act; (4) the discharge was not permitted under federal, state, or local law; and (5) natural resources under the trusteeship of a trustee may have been injured as a result of the incident (15 C.F.R. § 990.41 (a)). As provided at 15 C.F.R. § 990.14(c)(1) and LAC 43:XXIX.115, the Trustees invited Sunoco to participate in the NRDA (see Section 1.5). Sunoco was involved in the design, performance, and funding of several Preassessment activities to collect ephemeral data.

The Trustees also determined, pursuant to 15 C.F.R. § 990.42, that the requisite conditions existed to proceed beyond the Preassessment phase to Restoration Planning, including: (1) data collected pursuant to 15 C.F.R. § 990.43 demonstrated that injuries to natural resources had resulted from the Incident; (2) response actions did not adequately address the injuries; and (3) feasible restoration alternatives existed. Based on these determinations and in accordance with 15 C.F.R. § 990.44 and LAC 43:XXIX.123, on August 20, 2017, the Trustees issued a Notice of Intent to Conduct Restoration Planning for the Incident (see Section 1.6).

In Louisiana, the Regional Restoration Planning Program (RRP Program) was established to address incidents under OPA and OSPRA and make the NRDA process as a whole more efficient in Louisiana. The RRP Program identifies the statewide Program structure, decision-making process, and criteria that are used to select the restoration project(s) that may be implemented to restore the trust resources and services injured by a given incident. The goals of this statewide Program are to: 1) expedite and reduce the cost of the NRDA process; 2) provide for consistency and predictability by describing in detail the NRDA process, thereby increasing understanding of the process by the public and industry; and 3) increase restoration of lost trust resources and services. A complete description of the RRP Program is provided in the RRP Program Final Programmatic Environmental Impact Statement (FPEIS) (NOAA et al. 2007).

As described in Section 3.2.4.2 of the RRP Program FPEIS, in the Restoration Planning phase, the Trustees evaluate and quantify the nature and extent of injuries to natural resources and services, and determine the need for, type of, and scale of appropriate restoration actions. The first component of the Restoration Planning phase is injury assessment. For this Incident, the Trustees quantified injury to the following four resource categories: (1) mixed forest, including hardwood-loblolly pine, pine plantation and small stream forest; (2) bayhead swamp; (3) aquatic habitat, including the water channel, substrate (soil/sediments) and closely associated invertebrates of Tete Bayou and associated waterways; and (4) wildlife, including reptiles, mammals, amphibians, and other fauna such as birds and fish. The Trustees' assessment used data from the Trustees, Sunoco (when validated), and other sources. The Trustees' assessment produced relevant information for determining the nature and extent of injuries to natural resources, as described in Chapter 3.

The second component of the Restoration Planning phase is restoration selection. Considering the nature and extent of exposure and/or injuries to natural resources caused by the Incident, the Trustees developed a plan for restoring the injured resources and their services, set forth in this Final DARP. Chapter 4 summarizes the process the Trustees followed pursuant to the RRP Program to identify appropriate restoration types, identify potential restoration actions based on restoration type, and select a preferred restoration alternative to compensate the public for injuries quantified by the Trustees. Prior to selecting their preferred restoration alternative, the Trustees requested public review of the Draft DARP (see Section 1.6).

1.5 Coordination with the Responsible Party

The OPA and OSPRA regulations direct the trustees to invite the Responsible Party (RP) to participate in the NRDA process (15 C.F.R. § 990.14 and LAC 43:XXIX.115). Accordingly, the Trustees delivered a formal invitation to Sunoco on October 22, 2014 to participate in a cooperative NRDA for the Incident. Sunoco, on behalf of itself and Mid-Valley, formally accepted the Trustees' invitation on November 16, 2014, and participated cooperatively with the Trustees to address injuries to natural resources and services resulting from the Incident. Information collected by all parties was shared, as were the results of analyses undertaken independently by the Trustees and Sunoco. Coordination between the Trustees and Sunoco reduced duplication of effort, increased the cost-effectiveness of the assessment process, and increased sharing of information. As required by the regulations at 15 C.F.R. § 990.14 (c)(4), the Trustees retain final authority to make determinations regarding injury and restoration.

While proceeding with the injury assessment for the Incident, the Trustees also participated in settlement negotiations with Sunoco. In August 2021, the Trustees and Sunoco, on behalf of itself and Mid-Valley, reached an agreement to: (1) provide funding by Sunoco to the Trustees to restore, replace, or acquire the equivalent of the natural resources allegedly injured, destroyed or lost as a result of the Incident; (2) provide payment by Sunoco to the Trustees to reimburse the remaining unpaid NRDA costs incurred by the Trustees; and (3) resolve the Trustees' claims against Sunoco and Mid-Valley for natural resource damages under OPA and OSPRA. The settlement was negotiated by the parties in good faith and was intended to avoid potentially prolonged and complicated litigation and expedite natural resource restoration actions to be performed by the Trustees. It was fair, reasonable, and in the public interest consistent with the purposes of OPA and OSPRA. A proposed Settlement Agreement was made available to the public for 30-day review and comment in accordance with Section 1006(c)(5) of OPA, 33 U.S.C. § 2706(c)(5), and LAC 43:XXIX.131 and 135 (see Section 1.6). No comments were received and the Settlement Agreement was finalized and became effective on November 2, 2021.

1.6 Public Participation

Throughout the Restoration Planning phase of the NRDA, the Trustees have provided information to the public on the status of injury assessment and restoration selection to facilitate public involvement in the process. In August 2017, the Trustees published a Notice of Intent to Conduct Restoration Planning in the Louisiana Register (Vol. 43, No. 08, pp. 1695-1697, August 20, 2017) and in two newspapers of general circulation in Louisiana, *The Caddo Citizen* (Caddo Parish) and *The Advocate* (Baton Rouge). The Notice informed the public that, based on Preassessment findings, the Trustees were proceeding with Restoration Planning under OPA and OSPRA and opening an Administrative Record (AR) to facilitate public involvement in the Restoration Planning process (see Section 1.7). In August 2021, the Trustees published a Notice of Settlement Agreement in the Louisiana Register (Vol. 47, No. 08, pgs. 1201-1202, August 20, 2021), as well as in *The Caddo Citizen* and *The Advocate*, seeking 30-day public review and

comment of the proposed Settlement Agreement with Sunoco and Mid-Valley (see Section 1.5). The Trustees did not receive any comments.

On May 20, 2022, the Trustees published a Notice of Availability of a Draft DARP in the Louisiana Register (Vol. 48, No 5, pgs. 1437-1438), *The Advocate* (Baton Rouge), and in the *Caddo Citizen* (Caddo Parish). This Notice stated that the Trustees were seeking 30-day public review of the Draft DARP. The Trustees did not receive any comments.

1.7 Administrative Record

The Administrative Record (AR) documents the basis for Trustee decisions pertaining to restoration and includes documents relied upon by the Trustees during the assessment. The information provided in the AR can facilitate public participation during Restoration Planning and will be available for use in future administrative or judicial review of Trustee actions to the extent provided by federal and state law. Additional information and documents, including restoration planning documents, will be included when complete. The AR can be viewed digitally by going to the following web address: https://data.losco.org/.

2 ENVIRONMENTAL SETTING

The Incident location, as noted in Section 1.2, is found in Region 9 of Louisiana's RRP Program as depicted in Figure 2.1. A broad description of the affected environment and regional boundaries is provided in Sections 2.0 and 5.0 of the RRP Program FPEIS, respectively. The subsequent sections in this chapter present a description of the physical, ecological, and cultural and human-use environments found in Region 9 and associated habitat and fauna impacted by the Incident.

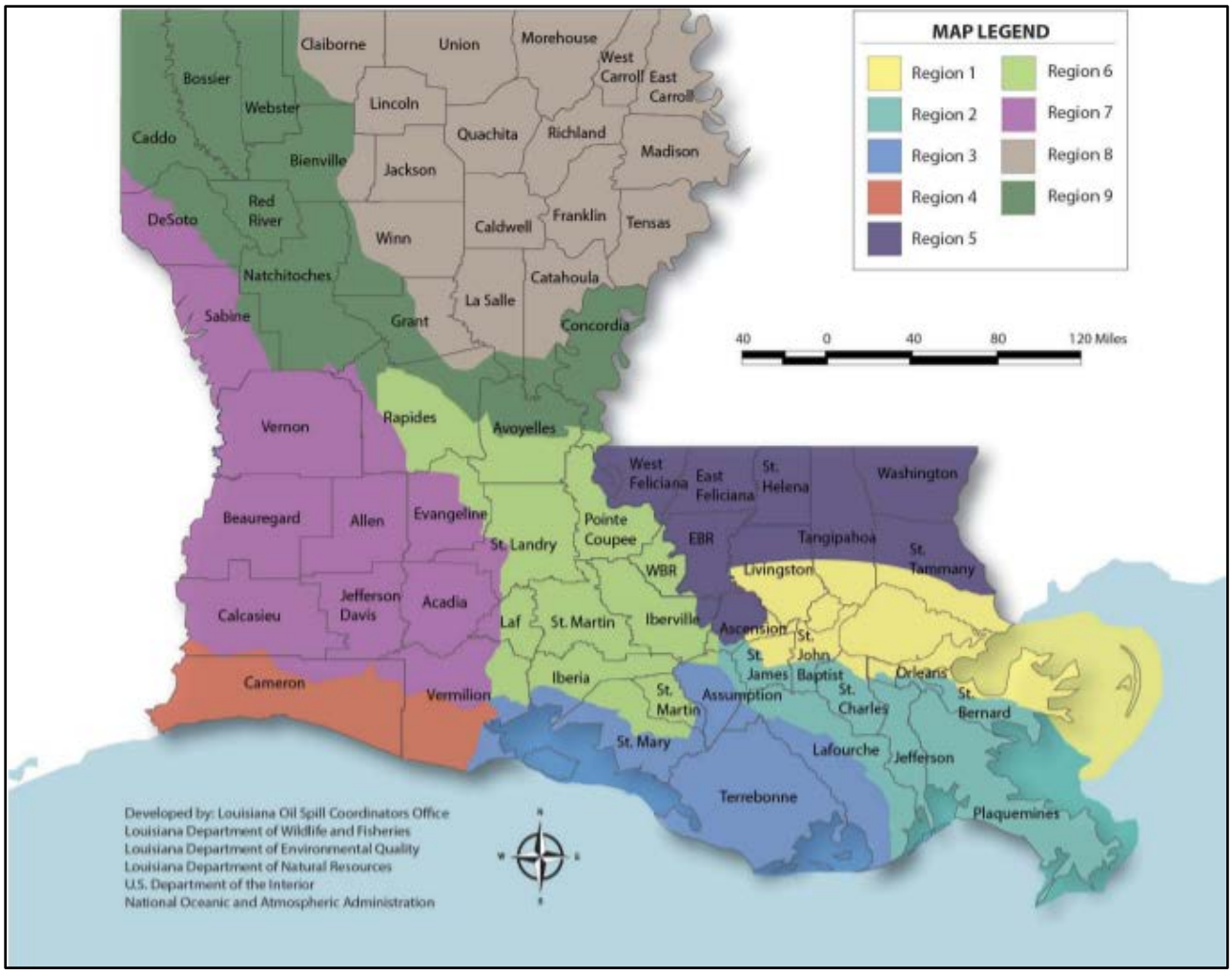

Figure 2.1 Regional boundaries for the RRP Program and parishes

2.1 Physical Environment

Region 9 is composed of three Major Land Resource Areas that include the Western Coastal Plain, Red River Alluvium, and Southern Mississippi River Alluvium (Natural Resources Conservation Service 2006; Weindorf 2008). The Western Coastal Plain area within Region 9

borders both sides of the Red River as it flows from the northwestern to central portion of the state. Areas of Region 9 in the northwestern and central portion of the state also include the Red River Alluvium while the eastern portion of Region 9 includes the Southern Mississippi River Alluvium. The Incident location is found in the Western Coastal Plain.

The majority of Region 9 lies within the Red Basin while eastern portions of Region 9 lie within the Mississippi Basin (Holcomb et al. 2015). Region 9 groundwater is contained within portions of seven major Louisiana aquifers including: Red River Alluvial Aquifer, Mississippi River Alluvial Aquifer, Carrizo-Wilcox Aquifer, Upland Terrace Aquifer, Catahoula Aquifer, Sparta Aquifer, and Cockfield Aquifer (Stuart et al. 1994). The Incident location is situated within the Red Basin and Carrizo-Wilcox Aquifer systems.

2.1.1 Landforms

The Western Coastal Plain portion of Region 9 consists of level to steep uplands that are intricately dissected by streams, some of which can have broad flood plains and terraces.

The Red River Alluvium and Southern Mississippi River Alluvium portions of Region 9 are characterized by landforms that consist of level or depressional to very gently undulating alluvial plains, backswamps, oxbows, natural levees, and terraces. Landform shapes range from convex on natural levees and undulating terraces to concave in oxbows. Landform shapes differentiate water-shedding positions from water-receiving positions, both of which have a major effect on soil formation and hydrology (Weindorf 2008).

2.1.2 Geology

Tertiary and Cretaceous marine sediments underlie most of the Western Coastal Plain portion of Region 9. The Tertiary marine sediments consist of interbedded sandstone, siltstone and shale, and unconsolidated sands, silts, and clays, while Cretaceous marine sediments are of minor extent and consist of calcareous clays and marls. Sand, silt, and clay alluvium is under the flood plains and terraces along the major drainages (Weindorf 2008).

Bedrock in the Red River Alluvium and Southern Mississippi River Alluvium portions of Region 9 consists of Tertiary and Cretaceous sands formed as beach deposits during the retreat of the Cretaceous ocean from the midsection of the United States. Alluvial deposits from flooding and lateral migration of the rivers typically lie above the bedrock. These sediments are sandy to clayey fluvial deposits of Quaternary age and are many meters thick (Weindorf 2008).

2.1.3 Soils

The dominant soil orders in the Western Coastal Plain portion of Region 9 are Alfisols and Ultisols. They dominantly have a siliceous, mixed, or smectitic mineralogy. They generally are very deep, well-drained to poorly drained, and loamy or clayey (Weindorf 2008).

The dominant soil orders in the Red River Alluvium and Southern Mississippi River Alluvium portions of Region 9 are Vertisols, Entisols, Inceptisols, and Alfisols. They dominantly have a smectitic clay and mixed sand and silt fraction mineralogy. The soils are loamy or clayey and very deep. In general, Red River Alluvium soils are poorly drained to moderately well-drained and Southern Mississippi River Alluvium soils are dominantly poorly drained and somewhat poorly drained (Weindorf 2008).

2.1.4 Climate

The climate of Louisiana is classified as subtropical and is governed by various terrestrial and atmospheric controls. Situated along the northern Gulf of Mexico between 29° and 33° north latitude, Louisiana's climate and temperature patterns are strongly influenced by seasonal changes in atmospheric circulation. Climate patterns differ across the state. Precipitation in Louisiana is largely due to convectional activity and extratropical storms during the summer and winter months, respectively. Summer precipitation is most common during the mid-afternoon. Winter precipitation is associated with extratropical storms and cold front passages.

Northern Louisiana records larger annual temperature variations and lower average annual rainfall than southern Louisiana because it is further from the influences of the Gulf of Mexico. Generally, average annual temperature throughout Region 9 is 66°F, with an average maximum temperature of 77°F and average minimum temperature of 55°F (NOAA 2021). In central and north Louisiana, which includes Region 9, freezing temperatures (32°F or lower) are recorded on 30 to 40 days during an average year. Average annual precipitation for Region 9 is 56 inches (NOAA 2021).

2.1.5 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 and track trends in air quality. There are three ambient air monitoring sites in Region 9 (two in Caddo and one in Bossier 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 does better than the primary standard is classified as an attainment area. Areas that violate national ambient air quality standards 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. Caddo Parish is classified as an

attainment area. Standards for each pollutant and attainment status for Louisiana are provided at https://www.deq.louisiana.gov/page/ambient-air-monitoring-program.

2.1.6 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 2020). 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 2020). Based on existing data, water quality is determined to be either fully supporting or not supporting those uses.

LDEQ maintains a website and web portal where results of water quality monitoring can be viewed (https://deq.louisiana.gov/page/ambient-water-quality-monitoring-data). There are currently 497 monitoring subsegments in Louisiana with 98 of those wholly or partially located within the boundaries of RRP Program Region 9 (LDEQ n.d.).

2.2 Ecological Environment

A broad description of habitat types present in Region 9 is provided in the RRP Program FPEIS. Common biota found in Region 9 are summarized in Appendix B and are taken from the RRP Program FPEIS. A summary of the natural community as well as a listing of the Threatened and Endangered Species specific to Region 9 which includes the Incident location are provided in the following sections.

2.2.1 Natural Community

The Western Coastal Plain portion of Region 9 is distinguished by a wide range of natural community types but is primarily known for its Longleaf Pine Woodlands, which are found in association with Hardwood Slope Forests and Mixed Hardwood-Loblolly Forests that develop on mesic soils. Bayhead Swamps, Small Stream Forests, Bottomland Hardwood Forests, and Cypress-Tupelo-Blackgum Swamps develop on wet bottomlands. Western Hillside Seepage Bogs occur along slopes and at lower elevations. Depending on the formation type and degree of uplift, calcareous clays, sandstones, saline deposits, siltstones, and ironstones have shaped the development of natural communities such as the Calcareous Forests, Calcareous Prairies, Saline Prairies, and Sandstone Glades/Barrens. The upper portion of the Western Coastal Plain in Region 9 was once recognized as the Shortleaf Pine-Oak-Hickory Woodland region of Louisiana (Newton 1972). Upon settlement, the majority of the shortleaf pine was logged and has been

replaced most recently by loblolly pine plantations. However, some natural stands of Shortleaf Pine-Oak-Hickory Woodland still exist in this region. Xeric Sandhill Woodlands occur on xeric sands in the upper Western Coastal Plain (Holcomb et al. 2015).

Both the Red River Alluvium and the Southern Mississippi River Alluvium areas located within Region 9 once consisted entirely of bottomland hardwood deciduous forest and mixed hardwood and cypress swamps before much of it was cleared for cultivation. The Southern Mississippi River Alluvium area contained one of the largest continuous wetland systems in North America. The widespread loss of forest and wetland habitat, however, has affected wildlife and reduced bird populations, although it is still a major bird migration corridor. Today, constructed levees restrict the river from overflowing, opening large areas for extensive agricultural use (Daigle et al. 2006).

The location of the specific habitats impacted by the Incident are depicted in Figure 2.2 and are best characterized as pine plantations, mixed hardwood-loblolly pine forests, small stream forests, and bayhead swamps. Pine plantation encompasses the Incident origin and consists of managed loblolly pine (*Pinus taeda*). Hardwood-loblolly pine runs streamside and consists of loblolly mixed with various hardwood tree species including sweetgum (*Liquidambar styraciflua*), beech (*Fagus grandifolia*), water oak (*Quercus nigra*), American elm (*Ulmus americana*), southern magnolia (*Magnolia grandiflora*), red maple (*Acer rubrum*), and pignut hickory (*Carya glabra*). Small stream forest is the dominant habitat type within Tete Bayou and includes water oak, white oak (*Quercus alba*), sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), shagbark hickory (*Carya oveta*), winged elm (*Ulmus alata*), and beech. Bayhead swamp is located within the lower reaches of Tete Bayou and shares the same tree species as the small stream forest but select species dominate the canopy including bald cypress (*Taxodium distichum*), pond cypress (*Taxodium ascendens*), sweetgum, red maple, southern magnolia, and water tupelo (*Tupelo aquatica*). Longleaf pine (*Pinus palustris*) and slash pine (*Pinus elliottii*) are sometimes present as well.

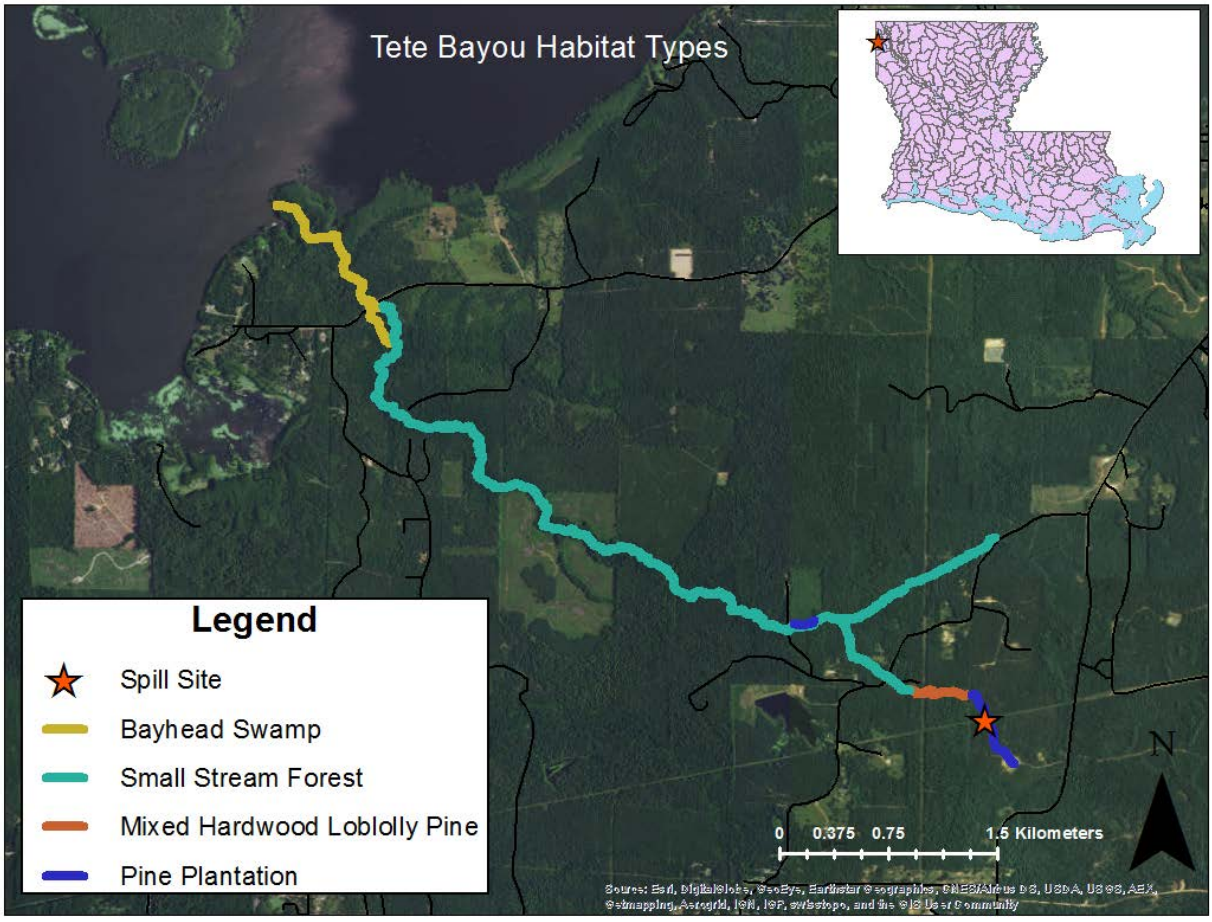

Figure 2.2 Map depicting the distribution of the four terrestrial habitats that were identified adjacent to the impacted stream channel

2.2.2 Threatened and Endangered Species

The Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. § 1531, et seq.) instructs federal agencies to carry out programs for the conservation of endangered and threatened species and to conserve the ecosystems upon which these species depend. The LDWF's Wildlife Diversity Program also identifies species that are Species of Greatest Conservation Need to the state. As of November 6, 2020, the published list of threatened and endangered species for the State of Louisiana includes 36 animal and three plant species (USFWS 2020).

Table 2.1 provides a list of nine federal and state recognized threatened or endangered species known to occur in the parishes of Region 9. There are no critical habitats identified in the affected environment as defined by the United States Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) (USFWS 2022; NOAA 2022).

Table 2.1 Threatened and endangered species that may be found in Region 9. Those species found in Caddo Parish are marked with an asterisk (LDWF n.d.; USFWS 2020).

Species	Federal Status[1]	State Rank[2]
Mammals		
Northern Long-eared Bat* *Myotis septentrionalis*	Threatened	S1
Birds		
Interior Least Tern* *Sterna antillarum athalassos*	Delisted	S1B
Red-cockaded Woodpecker* *Leuconotopicus borealis*	Endangered	S2
Fish/Aquatic Organisms		
Pallid Sturgeon* *Scaphirhynchus albus*	Endangered	S1
Shovelnose Sturgeon *Scaphirhynchus platorynchus*	Endangered	Not listed
Fat Pocketbook *Potamilus capax*	Endangered	S1
Louisiana Pearlshell *Margaritifera hembeli*	Threatened	S1
Reptiles		
Alligator Snapping Turtle* *Macrochelys temminckii*	Proposed Threatened[3]	S3
Louisiana Pinesnake *Pituophis ruthveni*	Threatened	S2
Vegetation		
Earth fruit* *Geocarpon minimum*	Threatened	S2

[1] Current federally listed species lists for Region 9 parishes can be found at: https://www.fws.gov/southeast/pdf/fact-sheet/louisiana-ecological-services-field-office-t-and-e-species.pdf

[2]All state rank definitions can be found at: https://www.wlf.louisiana.gov/page/rare-threatened-and-endangered-ranks-and-statuses

S1 = 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.

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.

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

S3=Vulnerable in Louisiana and at moderate risk of extirpation due to a fairly restricted range, relatively few populations or occurrences (21 to 100 extant populations), recent and widespread declines, threats, or other factors.

[3]Proposed Threatened on November 9, 2021, final listing and 4(d) rule is due November 9, 2022

2.3 Cultural and Socioeconomic Resources

2.3.1 Culture

Louisiana's culture has roots in both French and Spanish heritage but has been influenced by the presence of Native Americans and the many waves of immigrants to the area over the years (including Irish, German, Italian, Czech, Hungarian, Croatian, Filipino, Hispanic, and East Asian settlers). However, the cultural environment is not homogeneous throughout the state. Scholars typically divide the state into three major cultural regions: New Orleans, South Louisiana, and North Louisiana, each with its own history, influences, and traditions. Region 9 falls within the North Louisiana cultural region. Major cities within Region 9 such as Shreveport, Natchitoches, and Alexandria historically were tied to large plantations along the Red River. Shreveport, the largest city in North Louisiana, is home to a diverse mix of cultures including British Americans (especially Scotch-Irish), African Americans, Italians, Lebanese, Germans, Greeks, and Chinese. Founded in 1714, Natchitoches was the earliest settlement in the Louisiana Purchase. It was settled by the French, who wanted to tie into the Indian trade system, which at the time was dominated by the Caddo Indians (Louisiana Division of the Arts 2019).

The National Register of Historic Places (NRHP) is the official list of the Nation's historic places worthy of preservation. Significant archaeological and architectural properties are defined by eligibility criteria for listing on the NRHP in consultation with the Louisiana Office of Cultural Development, Division of Historic Preservation, which functions as the State Historic Preservation Office in Louisiana. The NRHP lists 1,325 historic districts, buildings, and structures in the State of Louisiana and 201 in Region 9 (National Park Service n.d.).

2.3.2 Population

The population of the State of Louisiana was over 4.6 million in 2019 (US Census Bureau n.d,). Population in Region 9, encompassing all or parts of the parishes which fall within the regional boundary (see Figure 2.1), totaled 880,676 and ranged from 4,334 (in Tensas Parish) to 240,204 (in Caddo Parish) (US Census Bureau n.d.). According to US Census Bureau data (n.d.), the population of the State of Louisiana and those parishes included in Region 9 is primarily White and Black or African American with American Indian/Alaskan Native, Asian, Native Hawaiian/Pacific Islander, and Hispanic/Latino also being reported (US Census Bureau n.d.).

2.3.3 Infrastructure and Public Services

Physical infrastructure and public services include commonly provided federal, state, parish, municipal, and/or private facilities that support development and protect public health and safety. This includes, but is not limited to, transportation (highways, roads, bridges, ferries, rails, airports, ports, and navigation), flood protection (levees, floodways, channel improvement and stabilization, and principal tributary basin improvements), health care facilities, and police and

fire protection. The following table provides information about infrastructure in the State of Louisiana, Region 9, as well as Caddo Parish, the parish in which the Incident occurred.

Table 2.2 Infrastructure in Louisiana, RRP Program Region 9, and Caddo Parish (US DOT 2020; US Census Bureau 2021)

Infrastructure Type	Louisiana	RRP Program Region 9	Caddo Parish
Roads	128,883 miles	23,841 miles	4,579 miles
Railways	3,381 miles	719 miles	167 miles
Airports, Heliports, & Seaplane Bases	733	76	25
Bridges	12,844	2,267	683
Locks	26	5	1
Dams	56	27	4
Ferries	16	0	0
Major Ports	11	1	0
Other Ports	2,572	48	8
Boat Ramps & Marinas	720	174	19

Region 9 has several major waterways that flow through the area including portions of the Ouachita, Black, Tensas, and Red Rivers. A small portion of the Mississippi River is present on the eastern border of Region 9. The prominent waterway, which runs from north to south through Region 9, the Red River, originates in Texas and Oklahoma, and carries its reddish-orange sediment southeast as it flows through northern and central Louisiana. The levee system on the Red River includes five locks within the boundaries of Region 9 (US DOT 2020). Region 9 also has many beautiful lakes some of which are termed “raft lakes” such as Caddo, Bistineau, Cross, Saline, and Nantachie Lakes. These are lakes that initially formed when water backed-up from a log jam in the Red River (The Great Raft) and flooded thousands of acres. The log jam sustaining the lakes was removed in the late 1800s to facilitate navigation on the Red River, which contributed to the de-watering of the lakes. Later in the 1900’s, dams were installed on the lakes to maintain water levels creating reservoirs that today provide high quality recreational areas.

In Region 9, the Central Louisiana Regional Port (CLRP) is the only major port in the area. Located on the Red River, it is ranked the 116th busiest port in the nation by tonnage in 2019 (USACE 2021). Region 9 is home to 48 smaller ports including the Port of Caddo-Bossier, Red River Parish Port, and Natchitoches Parish Port (CLRP 2015; US DOT 2020).

2.3.4 Economy

Timber production, agriculture, livestock grazing, and oil and gas production are major land uses in Region 9 and strongly shape the region's economy. Along the Red River and Mississippi River corridors of Region 9, most natural woodland has been cleared for cropland and improved pasture, although some woodland still occurs in very poorly drained and frequently flooded areas. Cotton, soybeans, corn, wheat, and rice are principal crops in these areas with some sugarcane (Weindorf 2008). Agricultural production of crops and livestock, poultry and other products accounted for approximately $855 million in market value of products sold in 2017 in Region 9 (USDA 2019a). All parishes that fall within the Region 9 boundary have 25% or greater forested surface area. As a result, timber production and forestry are also very important in this area (Greene and Brasher 2020).

The Shreveport-Bossier city area of Region 9 attracts most of the foreign and domestic tourists. In 2018, the Shreveport-Bossier City area had a visitor spending (domestic and foreign visitors) figure of $1.0 billion, which was third in the State to New Orleans and Baton Rouge, which had $8.3 and $1.4 billion, respectively. Shreveport contributed $341 million in direct earning and about 14,300 direct jobs generated by visitor spending, and generated $93 million in state taxes and $36 million in local taxes. Caddo Parish, located in Region 9, was in the top seven parishes that generated the largest spending by visitors in 2018 (University of New Orleans 2019).

Louisiana's oil and natural gas industry began in 1901 producing oil in commercial quantities and is closely linked to the Region 9 area. In 1908, the first natural gas pipeline was laid in Louisiana, transporting gas from Caddo Field to Shreveport, Louisiana. Construction commenced on the first long-distance oil pipeline in 1909, and by 1910, crude oil was being transported from Caddo Parish in northwestern Louisiana to Baton Rouge, Louisiana. Around 1910, the first over-water drilling occurred on Caddo Lake near Shreveport, Louisiana. The next several decades were dominated by the discovery of the oil and natural gas fields across the state and eventually offshore Louisiana. The Haynesville Shale, Tuscaloosa Marine Shale, and Austin Chalk Units have seen recent significant increases in oil and natural gas exploration activities throughout Region 9.

2.3.5 Land Management and Ownership

The USDA, U.S. Forest Service (USFS), manages Louisiana's only National Forest, the Kisatchie National Forest (KNF). The KNF is located in central and northern Louisiana and all five of the managed Ranger Districts, Kisatchie, Catahoula, Caney, Calcasieu, and Winn, are at least partially located in Region 9 (USDA n.d.). The USFS also manages the following wildlife management preserves as part of KNF, which are at least partially located in Region 9: Catahoula National Wildlife Management Preserve and Red Dirt National Wildlife Management Preserve (USDA 2019b, 2019c). In addition, in Region 9, the Saline Bayou is Louisiana's only designated national wild and scenic river and is located within the KNF and managed by the USFS. The USFWS – Fish and Aquatic Conservation program runs the Natchitoches National Fish Hatchery (NNFH), which is one of 69 federal fish hatcheries located across the United

States, and is the only federal fish hatchery located in Louisiana (USFWS n.d.). The USFWS manages 23 National Wildlife Refuges in Louisiana of which four, Red River, Grand Cote, Bayou Cocodrie, and Lake Ophelia, fall within the Region 9 boundary (LDWF 2020a).

In Region 9, the USACE manages six lakeside recreational areas that are generally moderate in size and offer a full range of facilities such as campgrounds, picnic areas, boat ramps, marinas, and hiking trails (USACE n.d.).

Louisiana Department of Culture, Recreation, and Tourism – Office of State Parks manages State Historic Sites and State Recreational Parks. Region 9 contains five State Historic Sites and one state park: Rebel State Historic Site, Los Adaes State Historic Site, Fort Jesup State Historic Site, Fort St. Jen Baptiste State Historic Site, Forts Randolph and Buhlow State Historic Sites, and Lake Bistineau State Park (Louisiana Office of Tourism & Office of the Lt. Governor 2021).

Within Region 9, the LDWF manages the nine Wildlife Management Areas of Bayou Pierre, Bodcau, Dewey W. Wills, Grassy Lake, Loggy Bayou, Pearson Ridge, Richard K. Yancey, Soda Lake, and Spring Bayou. In addition, LDWF manages seven designated natural and scenic rivers (LDWF 2020a).

Louisiana is home to more American Indian tribes than any other southern state, including four federally recognized sovereign nations, as well as 11 state-recognized tribes (Louisiana Office of Indian Affairs n.d.). Within Region 9, there are two federally recognized sovereign nations, the Jena Band of Choctaw Indians (Jena) and the Tunica-Biloxi Indians of Louisiana (Marksville), and three state-recognized tribes, Adai Caddo Indians of Louisiana, Clifton Choctaw Tribe of Louisiana, and the Natchitoches Tribe of Louisiana (US Census Bureau 2021).

3 INJURY ASSESSMENT AND QUANTIFICATION

This chapter describes and quantifies the nature, degree, and extent of injuries to natural resources and services resulting from the Incident. The chapter begins with an overview of data collected during the NRDA process. The following section describes the Trustees' assessment strategy, including the approaches used to identify, determine, and quantify potential injuries. The remainder of the chapter presents the results of Trustee injury assessments for the specific resources affected by the Incident.

3.1 Assessment Activities and Findings

The Trustees initiated Preassessment activities for the discharge shortly after notification of the incident. The Trustees focused on collecting ephemeral and other data pursuant to the OPA regulations (15 C.F.R. §§990.42-.43) that would assist the Trustees in determining whether: 1) injuries have resulted, or are likely to result, from the Incident; 2) response actions have not adequately addressed, or are not expected to address, the injuries resulting from the Incident; and 3) feasible primary and/or compensatory restoration actions exist to address the potential injuries.

The Trustees utilized the pre-identified potentially injured trust resources and services described in Section 4.2.2 of the RRP Program FPEIS early in the Preassessment phase of the NRDA for this Incident. Although only broadly defined, the potentially injured trust resources and services categories assist the Trustees in determining early on in the Preassessment phase of an incident the trust resources and services that may be injured as a result of the Incident. In addition, Preassessment activities were conducted during and after the response. The Trustees used information collected during the response such as ground-level photos, maps, Incident Action Plans, air monitoring reports, and wildlife response reports to begin to evaluate injuries caused by the discharged oil and response actions. Documentation of oiled and injured habitat and fauna was also used from two Preassessment NRDA site visits conducted on October 21, 2014 and January 14, 2015.

The Trustees considered potential natural resource and service injuries to the following four resource categories: (1) mixed forest, including hardwood-loblolly pine, pine plantation, and small stream forest; (2) bayhead swamp; (3) aquatic habitat, including the water channel, substrate (soil/sediments), and closely associated invertebrates of Tete Bayou and associated waterways; and (4) wildlife, including reptiles, mammals, amphibians, and other fauna such as birds, fish, and invertebrates. Table 3.1 details the case specific injured natural resource and service category and subcategory and the RRP Program injured resource and service category.

Table 3.1 The associated case-specific injured resource category and subcategory and RRP Program injured resource and service category

Case-Specific Injured Resource Category/Subcategory	RRP Program Injured Resource and Service Category
Mixed Forest Hardwood-Loblolly Pine Pine Plantation Small Stream Forest	Inland Upland Vegetation (IUV) Inland Forested Wetland (IFW)
Bayhead Swamp	Inland Forested Wetland (IFW)
Aquatic Habitat	Inland Beaches/Shorelines/Streambeds (IBSS)
Wildlife and other fauna	Wildlife

3.1.1 Impacts to Habitat

The Incident and associated response activities impacted aquatic and terrestrial habitats located within and adjacent to the Tete Bayou. Section 2.2 of this Final DARP describes these habitats and Table 3.2 and Figure 3.1 summarize and depict the habitat types, impacted acres, and associated injured resource categories.

Portions of the mixed forest habitat were clear-cut in order to create a series of pathways or trails to access and clean-up oil in and along Tete Bayou and nearby waterways during the response. These paths were clear-cut using a John Deere Doggett 333E with a chipper/shredding attachment. Additional response related injuries to mixed forest habitat included trampled or denuded vegetation caused by the foot traffic of approximately 400 clean-up personnel and use of heavy equipment and Utility Terrain Vehicle's. Figure 3.2 shows examples of the terrestrial habitat impacts caused by the response actions.

Approximately 0.25 miles south of Hereford Road along Tete Bayou, the habitat becomes predominantly bayhead swamp as it reaches Caddo Lake. The bayhead swamp habitat experienced direct oiling on water and in sediments with the presence of silver sheen on the water through at least the January 14, 2015 NRDA site visit.

Aquatic habitat injuries occurred within the initial drainage-way and intermittent stream located near the Incident source, along Miller Branch creek, in Tete Bayou, and associated unnamed tributaries of Tete Bayou. Thick blackish-green oil covered the surface water from bank to bank along all of these waterways. Seven dams were constructed during the response phase to contain oil in Miller Branch and Tete Bayou before the oil reached Caddo Lake. The earthen dams were eventually removed once the oil was collected and managed with maintenance operations. To facilitate timely and efficient oil removal within Tete Bayou, oiled natural woody material, including beaver dams, log jams, and cypress knees were removed from the aquatic habitat in the spill impacted area. Response documentation states that a final volume of 2,765 cubic yards of organic debris and contaminated soil and sediment was removed from the waterways and

surrounding areas of the impacted area. Response actions also included high pressure flushing of oiled bayou and banks with water to herd oil to collection points and flush oil from bayou banks. This process involved the uprooting of bayou bank vegetation, shrubs, and some small trees. At times, sections of the impacted waterways did not have enough water to continuously move oil from pools and crevices to collection points, so response personnel pumped high volume foreign pond water from a nearby 20-acre pond through hoses to flush the oil. During these high-energy bank washing and oil herding events, oil and oil-laden sediments were mixed into the water column. Overall, streambank sediments, bank vegetation, and woody material were disturbed, exposed to oil, removed, and eroded, decreasing the ecological function of the streambed and aquatic habitat. Figure 3.3 shows examples of the aquatic habitat impacts caused by oil and response actions, including oiled sediments in and around the streambed that were still evident during the last Preassessment site visit.

Table 3.2 Impacted acres for each habitat injured resource category

Case-Specific Injured Resource Category	**RRP Program Injured Resource and Service Category**	**Impacted Acres**
Mixed Forest	IUV, IFW	77.3
Bayhead Swamp	IFW	25.9
Aquatic	IBSS	10.1
Total		**113.3**

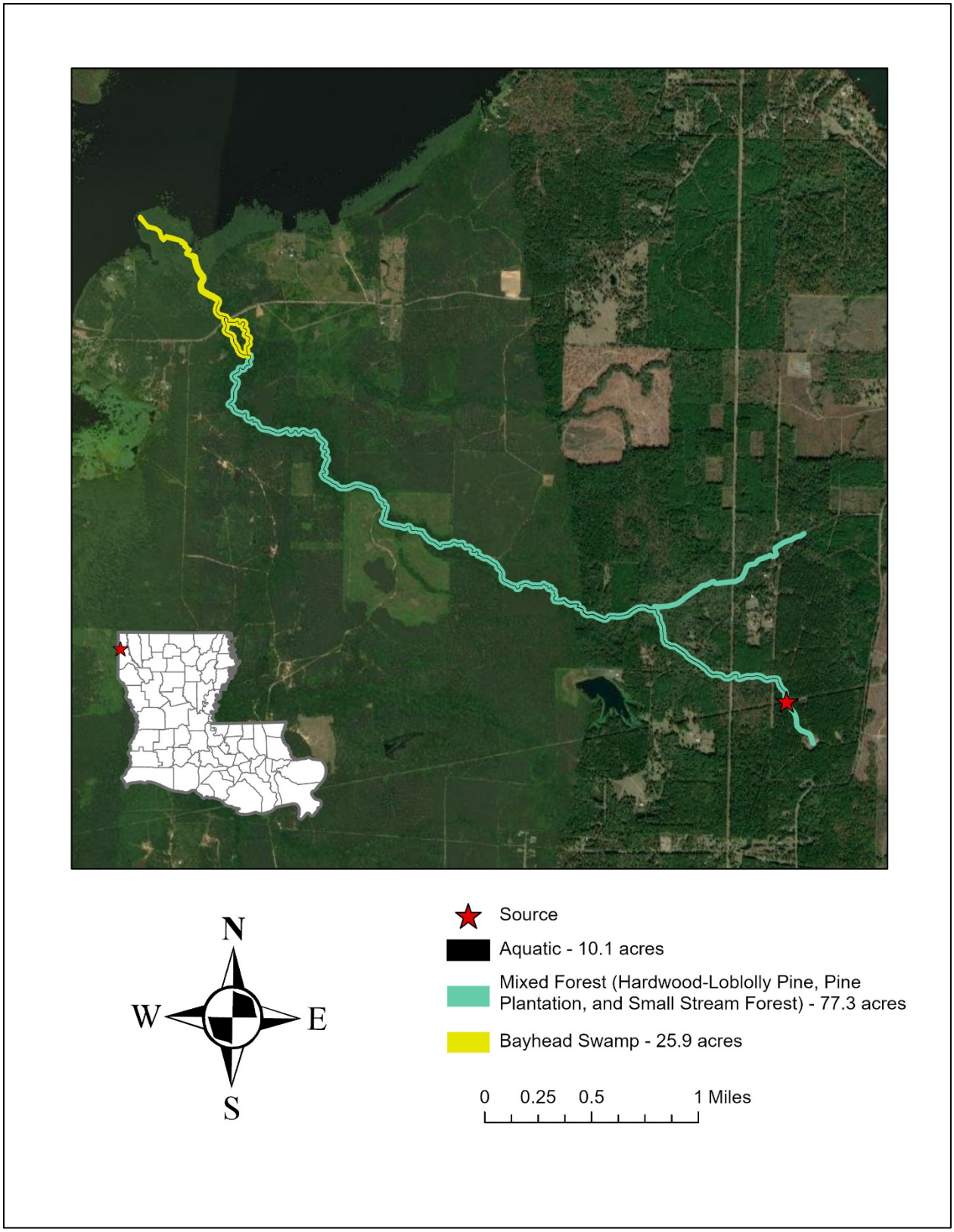

Figure 3.1 Map depicting injured resource categories within and adjacent to Tete Bayou

Figure 3.2 Photos documenting terrestrial habitat impacts caused response activities. A) Machinery used to clear-cut response paths, B) Portion of a clear-cut response path, C) Response personnel during clean-up, D) Disturbance along the Tete Bayou and mixed forest habitat during the response

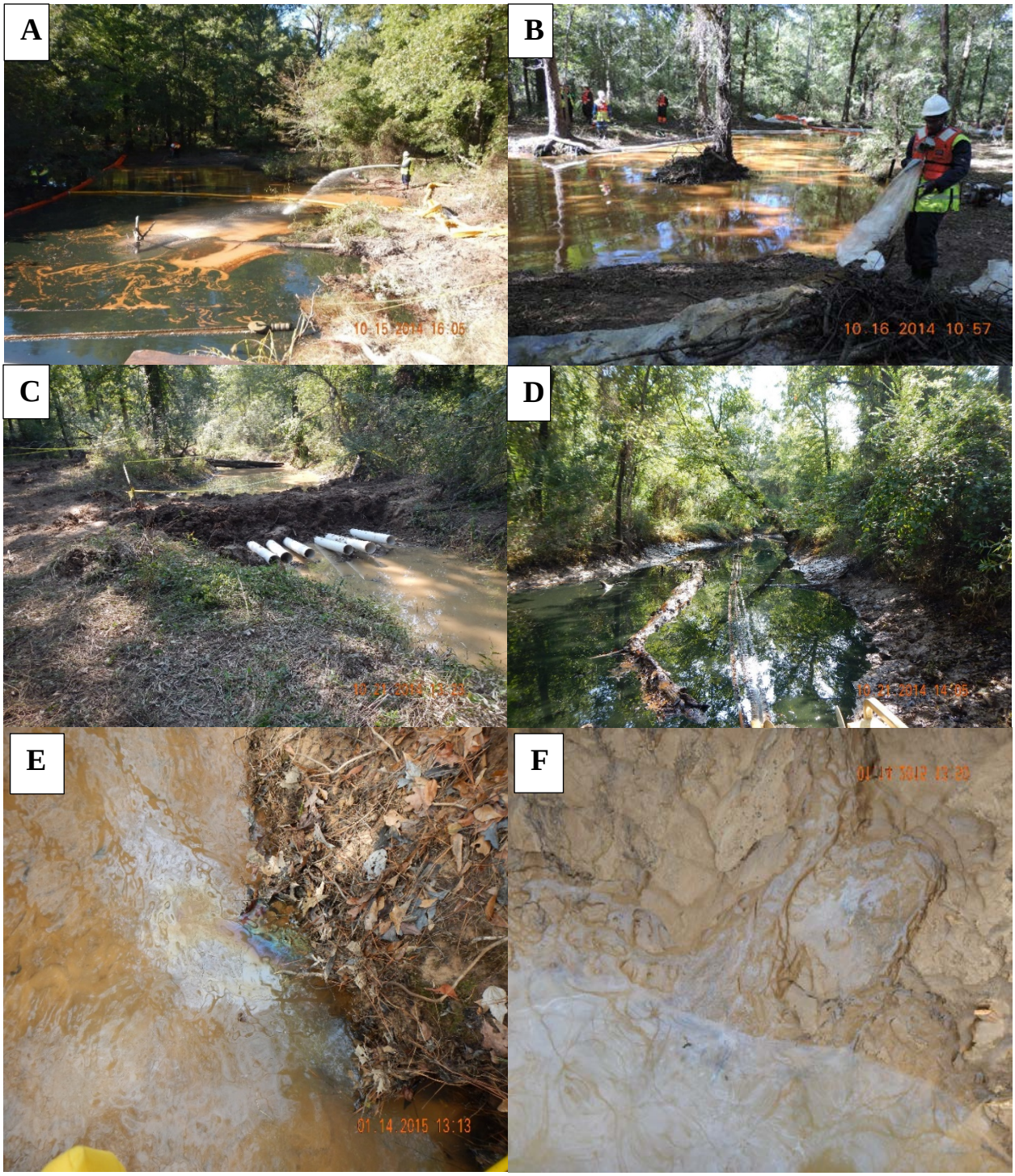

Figure 3.3 Photos documenting aquatic habitat impacts caused by response actions. A) High pressure flushing, B) Debris removal, C) Earthen dam constructed along Tete Bayou, D) Thick blackish-green oil covering the intermittent stream, E) Rainbow and silver sheen bubbled up from black sediments on the bottom of the affected bayou, F) Silver and rainbow sheen leaching down the bank into affected bayou undisturbed

3.1.2 Impacts to Wildlife

The Incident and associated response activities impacted a variety of fauna. For this case, reptiles, mammals, amphibians, and other fauna such as birds and fish represent the wildlife injury category. Wildlife response surveys along Tete Bayou occurred during the first three-weeks of the response. Table 3.3 details over 1,600 individual wildlife that were observed to be oiled or otherwise impacted as a result of the Incident, including many that were found dead or subsequently euthanized. There were times during the response when wildlife surveys in the heaviest oiled areas were not allowed due to high levels of volatile organic compounds. In addition, wildlife surveys did not occur in the late evenings, night, or early morning hours when some species are most active (e.g., birds, bats, coyotes, deer, etc.). Many more individuals were documented to be utilizing (e.g., nesting or feeding) oiled areas or near oil, including documentation of animal tracks and scat in oiled areas. Figure 3.4 documents wildlife affected by the Incident during response efforts.

Table 3.3 Observations of impacted wildlife during response surveys

Wildlife Category	**Number of Impacted Individuals Observed**
Turtles	49
Amphibians	881
Snakes	92
Mammals	12
Fish/Bivalves/Crustaceans	616
Wood ducks	5
Total	1,655

Trustees and Sunoco cooperatively conducted a Wildlife Study Plan in order to implement a comparative assessment of turtles and other wildlife species involving wildlife and habitat sampling that would aid the cooperative group in determining wildlife impacts. The activity consisted of five sampling events per the Wildlife Study Plan from May 5, 2015 through February 16, 2016. However, periods of drought and flooding at the study location led to unstable environmental conditions and as result, the data collected were inconclusive.

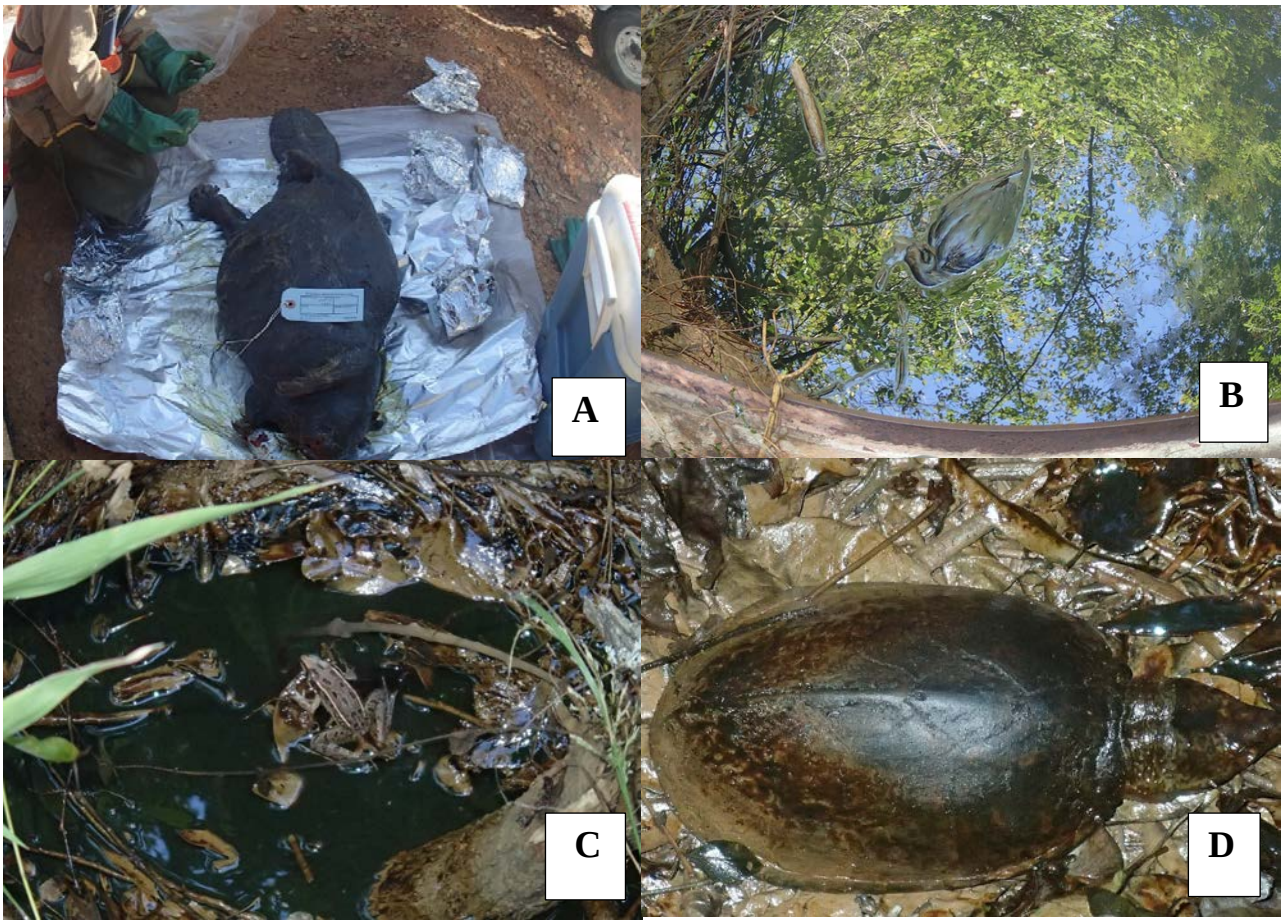

Figure 3.4 Wildlife affected by the Incident. A) Dead oiled beaver, B) Dead oiled bird, C) Live oiled frog surrounded by oil, D) Oiled turtle

3.2 Injury Assessment Approach

The goal of injury assessment under OPA and OSPRA is to determine the nature, degree, and extent of injuries, if any, to natural resources and their services in the affected environment to provide a technical basis for evaluating and scaling restoration actions. After identifying the injured resources for the Incident, the Trustees developed appropriate injury assessment procedures primarily based on: 1) information gathered during the Response and Preassessment phases of the Incident; 2) relevant peer-reviewed literature; and 3) best professional judgment of local experts and Trustees familiar with the effects of crude oil in similar environments.

3.3 Injury Assessment Methods and Quantification

For the quantification of injuries to mixed forest, bayhead swamp, and aquatic habitats, the Trustees used Habitat Equivalency Analysis (HEA) to quantify interim service losses (i.e., service losses incurred from the time of injury until recovery to baseline) (NOAA 2000). The

Trustees quantified interim service losses in terms of discounted service acre years (DSAYs), where one DSAY is equal to the flow of services provided by one acre of habitat over the course of one year and discounted over time. The input parameters required to calculate the debit-side of the HEA were: 1) total acres of injured habitat; 2) initial level of service losses; and 3) recovery curve of service flows over time. Using the injury parameters described in the following sections and applying a discount rate of three percent per year (NOAA 1999), the Trustees quantified natural resource injuries for the Incident.

The Trustees used Resource Equivalency Analysis (REA) to determine wildlife injury caused by the Incident. REA, first utilized in the North Cape Oil Spill for birds (Sperduto et al. 2003), uses a stepwise replacement model for killed or injured species. REA calculations using the stepwise replacement model involve basic population modeling, including elements of the Leslie matrix and associated life history tables, with appropriate discounting to provide the result in present value. This approach documents how many individual organisms are lost by age class over time in a stepwise fashion based on survival rates and longevity, and seeks to measure how much it costs to replace the natural resource services that the public lost because of the injury. In order to quantify injury to wildlife for this Incident, the Trustees decided to use a sentinel (or surrogate) species group to represent all wildlife injured for this Incident. The Trustees selected turtles as the sentinel species group. REA inputs for the Incident's wildlife injury based on turtle life history information include the number killed/removed, average age or identification of age classes killed/removed, survival rates, and reproductive rates (to account for foregone future generations) (Belzer 2002; Bowen et al. 2004; Buchman et al. 2010; Budischak et al. 2006; Dundee and Rossman 1989; Ernst 1986; Ernst and Lovich 2009; Gibbons 1990; Ligon and Lovern 2009; Lindeman 2008; Miller 2001; Mitchell 1988; Reed et al. 2002; Steyermark et al. 2008; Tinkle 1961). For this Incident, the Trustees used a REA model that quantified direct loss and future foregone generations (indirect) expressed in discounted turtle-years (DTYs) for equivalency calculations for all turtle species. See Section 3.3.2 for more information.

The following sections describe the results of the Trustees' injury assessment for the Incident.

3.3.1 Habitat

Using response and Preassessment data described above, the Trustees determined that 113.3 acres of mixed forest, bayhead swamp, and aquatic habitat were injured as a result of the Incident. To reflect varying degrees of oiling, response impacts, and expected recovery across the spill area, the mixed forest and bayhead swamp categories were further subdivided into acres of heavy and light injury, as depicted in Figure 3.5.

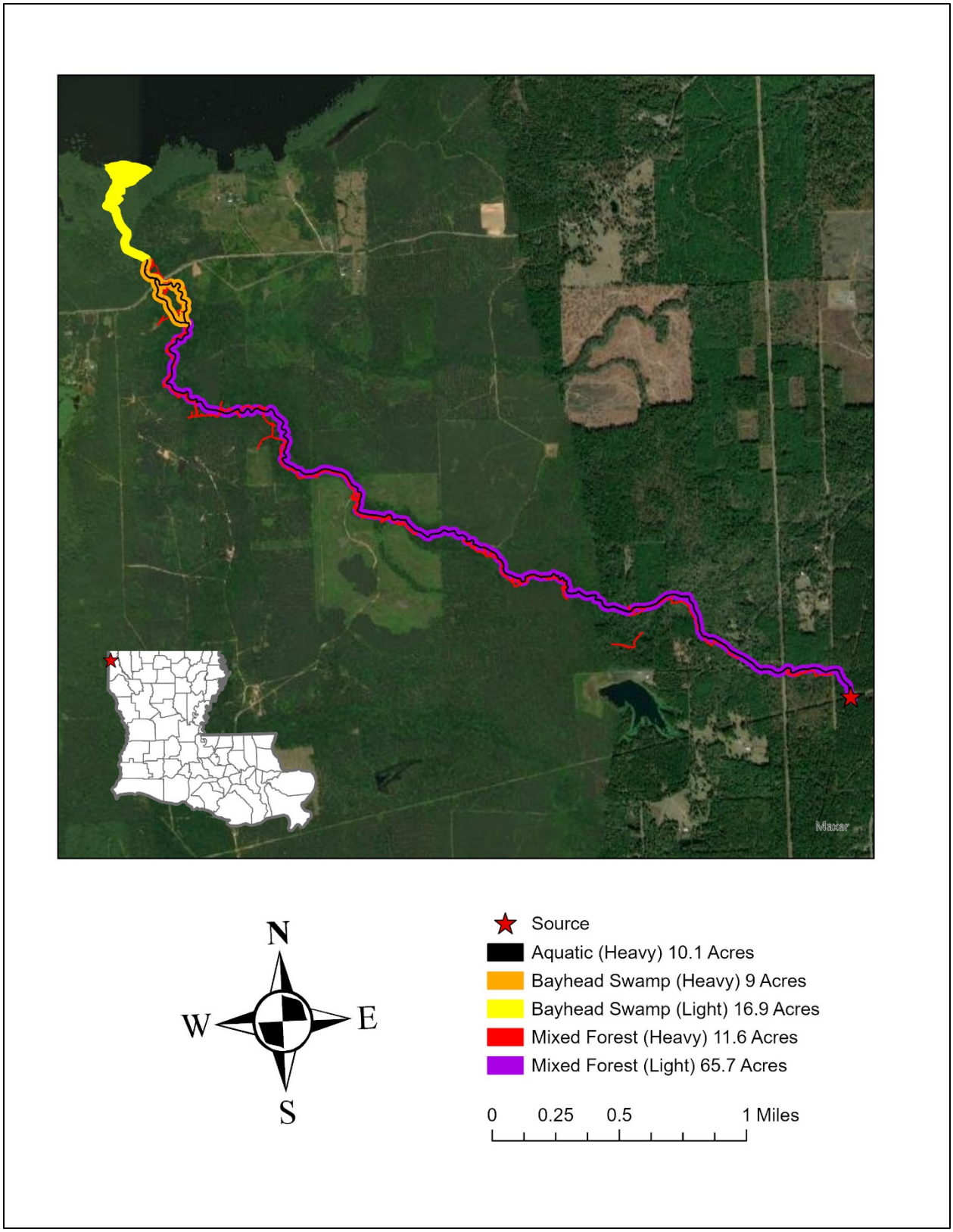

Figure 3.5 Map depicting the injured habitats, degree of injury, and acreages

To determine the level of initial service losses of habitats affected by the Incident, the Trustees assumed that, prior to the Incident, the habitats in the vicinity of the discharge were healthy and providing 100% ecological service flows. Emergency response and clean-up of oil took place for three months after initial notification of the Incident. Habitat was oiled and being disturbed at regular intervals during this period.

For the mixed forest (heavy) category, the Trustees determined that severe habitat changes and stresses related to clear-cutting the mixed forest occurred. Disturbances can cause changes in forest species composition and function, and alter the course of forest succession (Bazzaz 1979; Hicks et al. 2004). Although plants (e.g., herbaceous layer and eventually some softwood trees) will colonize the clear-cut areas, herbaceous recruitment favors invasive species and is less productive compared to tree species (Groninger and Long 2008; Webster et al. 2006;). Typically, after clear-cutting, the first tree species to emerge consist of shorter-lived, faster-growing softwoods instead of longer-lived hardwoods (Hicks et al. 2004). Numerous sweet gums, elms, and oaks were clear-cut in the mixed forest (heavy) areas. These long-lived species take a considerable amount of time (60+ years) to establish, reach maturity, and start producing mast (Harlow and Harrar 1969; Loehle 1987; Oliver and Larson 1996). Based on these factors, the Trustees assigned 100% initial service loss for three months to the mixed forest (heavy) category, with full recovery at year 65. This resulted in a loss of 228.75 DSAYs.

Although the disturbance to the mixed forest (light) category was less severe, soil compaction caused by response and clean-up actions is likely to be detrimental to seedling growth and survival (Jordan et al. 2003). As a result, the Trustees assumed this area experienced a 10% initial service loss for three months and a linear recovery to 100% ecological service flows over 24 months. This resulted in a loss of 8.31 DSAYs.

The Trustees determined that the bayhead swamp (heavy) category experienced heavier oiling due to the fact that the majority of the oil in this portion of the bayhead swamp habitat was contained in front of two underflow dams. The dams were designed to capture a large volume of oil which could be collected by responders. As a result, the Trustees applied a 50% service loss for three months with full recovery at year 7 (84 months) for a loss of 15.92 DSAYs in the bayhead swamp (heavy) category. The Trustees did not apply an initial service flow loss to the bayhead swamp (light) category because in this area, dams were erected quickly by response to successfully prevent the oil from entering this area and Caddo Lake. Once dams were removed at the end of emergency response, however, oily water and sediments flowed to the area. The Trustees therefore applied a linear decrease in service flows starting at month 3 and continuing over 30 months until 50% service flows were reached. The Trustees then assumed a linear recovery to 100% ecological service flows over the next 30 months. This resulted in a loss of 19.63 DSAYS for the bayhead swamp (light) category.

In the aquatic habitat, the Trustees initially observed heavy and consistent oiling and assumed 100% initial loss of services until the clean-up of oil was complete at the end of emergency response. During a Preassessment site visit in January of 2015, although the Trustees did not observe any free oil product, they did observe rainbow and silver sheen coming from disturbed

sediments and leeching from the streambank into the streambed. In addition, the Trustees and Sunoco cooperatively conducted a sediment sampling event on March 2, 2016. Sediment samples were collected to inform the recovery timeline for the aquatic habitat. Based on this information and best professional judgment, the Trustees assumed linear recovery of the aquatic habitat to 100% ecological service flows in 84 months resulting in a loss of 35.7 DSAYs. A summary of the acres injured, service loss and recovery time, and resulting DSAYs for each habitat injury category is provided in Table 3.4. Using HEA, the Trustees calculated a total loss/debit of 308.33 DSAYs of habitat.

Table 3.4 Summary of injured resources by habitat category and quantification of injured acres to DSAYs

Injured Resource Category (Degree of Injury)	**RRP Program Injured Resource and Service Category**	**Acres Injured**	**Service Loss and Recovery Time**	**Debit (DSAYs)**
Mixed Forest (heavy)	IUV, IFW	11.6	100% initial service loss for 3 months Full recovery at year 65	228.75
Mixed Forest (light)	IUV, IFW	65.7	10% initial service loss for 3 months Linear recovery for 24 months	8.31
Bayhead Swamp (heavy)	IFW	9.0	50% initial service loss for 3 months Linear recovery for 84 months	15.92
Bayhead Swamp (light)	IFW	16.9	At 3 months, linear decrease in services to 50% starts and ends at 30 months. Linear increase to 100% service flows for next 30 months	19.63
Aquatic (heavy)	IBSS	10.1	100% initial service loss for 3 months Linear recovery for 84 months	35.7
TOTAL		113.3		**308.33**

3.3.2 Wildlife

Wildlife were exposed to oil contamination via multiple means (direct contact, ingestion, respiratory, etc.) within the Incident location. As discussed in Section 3.3, Trustees selected turtles as the sentinel species (representing all wildlife injured) for the REA analysis. As seen in Table 3.5, during response and clean-up activities for this Incident, a total of 49 turtles (4 land based and 45 water based) were found either live oiled or dead oiled. All live oiled wildlife were collected, rehabilitated, and a percentage were released, away from the Incident location (thereby removing them from the breeding population).

Table 3.5 Summary of wildlife injury

Common Name	Scientific Name	# of Individuals Dead/Removed
Alligator snapping turtle	*Macrochelys temminckii*	3
Box turtle	*Terrapene carolina*	4
Common snapping turtle	*Chelydra serpentina*	2
Eastern river cooter	*Pseudemys concinna*	3
Razor-backed musk turtle	*Sternotherus carinatus*	19
Red-eared slider	*Trachemys scripta elegans*	12
Stinkpot (Eastern musk turtle)	*Sternotherus odoratus*	6
TOTAL		**49**

As described in Section 3.3, REA inputs for the Incident's wildlife injury include the number turtles killed/removed, average age or identification of age classes turtles killed/removed, survival rates, and reproductive rates. For these calculations, all individual turtles were assumed to be female and of an average age (based on average lifespan of the species). Direct losses are calculated based on the number of individual turtles observed dead/removed and indirect losses represent the production foregone as a result of those individual turtles no longer reproducing in the area. Service losses are quantified in terms of DTYs, where one DTY is equal to the flow of services provided by one turtle over the course of one year, and discounted over time at a 3% annual rate (NOAA 1999). The direct losses (individuals killed/removed) as well as indirect losses (production foregone) by species are provided in Table 3.6. The total loss for turtles (direct and indirect for all species) is 1,406.4 DTYs.

Table 3.6 Turtle losses calculated in DTYs

Common Name	Direct Loss (in DTYs)	Indirect Loss (in DTYs)	Total Loss (in DTYs)
Alligator snapping turtle	16.2	24.1	40.3
Box turtle	29.2	108.5	137.8
Common snapping turtle	24.1	148.3	172.4
Eastern river cooter	15.1	154.5	169.6
Razor-backed musk turtle	97.6	100.1	197.7
Red-eared slider	50.4	550.5	600.9
Stinkpot (Eastern musk turtle)	30.8	56.9	87.7
Total	**263.5**	**1,142.9**	**1,406.4**

3.4 Summary of Injury Assessment and Quantification

The outputs of the debit-side of the HEA for mixed forest, bayhead swamp, and aquatic habitats and the REA for turtles are provided in Table 3.7 for the Incident. Lost ecological services are

expressed in DSAYs for mixed forest, bayhead swamp, and aquatic injuries and DTYs for the wildlife injury.

Table 3.7 Summary of injuries for the Incident

Case-Specific Injured Resource Category (Degree of Injury)	RRP Program Injured Resource and Service Category	Amount Injured (acres/counts)	Injury
Mixed Forest (heavy)	IUV, IFW	11.6 (acres)	228.75 DSAYs
Mixed Forest (light)	IUV, IFW	65.7 (acres)	8.31 DSAYs
Bayhead Swamp (heavy)	IFW	9.0 (acres)	15.92 DSAYs
Bayhead Swamp (light)	IFW	16.9 (acres)	19.63 DSAYs
Aquatic (heavy)	IBSS	10.1 (acres)	35.7 DSAYs
Wildlife	Wildlife	49 turtles (direct kill and production foregone)	1,406.4 DTYs

4 RESTORATION ALTERNATIVES

The goal of restoration under OPA and OSPRA is to compensate the public for injuries to natural resources and their services resulting from an incident. This goal is achieved through the return of the injured natural resources and their services to baseline conditions and compensation for interim losses from the date of the incident until recovery. To fulfill this purpose, this section introduces potential restoration action(s) to restore the natural resources and resource services injured by the Incident and identifies one component of the Trustees' preferred restoration alternative.

The assessment completed by the Trustees described in Chapter 3 quantified the amount of injury to natural resources resulting from the Incident. Per Section 1006(c)(1)(C) of OPA, Trustee restoration actions must restore the equivalent of the injured resources by providing resources and services of the same type and quality and of comparable value (i.e., restore, rehabilitate, replace, or acquire the equivalent) as those injured. The process of "scaling" compensatory restoration actions involves determining the size of the restoration action(s) needed to provide resource and service gains equal to the value of interim losses due to the release of hazardous substances (NOAA 1997, 1999). Because the duration of the injury differs from the lifespan of the restoration action(s), equivalency is calculated in terms of the present discounted value of services lost due to resource injuries and gained due to restoration.

4.1 Restoration Strategy

Restoration actions are defined as primary or compensatory. Primary restoration actions are any actions, including natural recovery, that restore injured natural resources and services to their baseline condition (that is, their condition prior to the release of oil). Compensatory restoration addresses interim losses of natural resource services from the time of initial injury until full recovery of natural resources to their baseline condition. Natural recovery, in which no human intervention is taken to restore the injured resources, is appropriate where feasible or cost-effective primary restoration actions are not available or where the injured resources would recover relatively quickly without human intervention. The scale of primary and compensatory restoration projects depends on the nature, extent, severity, and duration of the resource injury. Primary restoration actions that speed resource recovery would reduce the scale of compensatory restoration required.

Although appropriate response actions were taken following the Incident, impacts to the environment were not fully restored. Accordingly, the Trustees determined that a number of potential restoration actions would be needed to compensate the public for the losses, and proceeded with Restoration Planning. For primary restoration, the Trustees considered both the natural recovery option and other actions that would restore the injured resources at the spill site. Based on the extent of injury, the natural recovery option was pursued for primary restoration but not for compensatory restoration, and for the purposes of this Final DARP natural recovery is the

No Action alternative as described in the following sections. For compensatory restoration, OPA and OSPRA regulations clearly establish Trustee authority to seek compensation for interim losses if technically feasible, cost-effective alternatives exist. Since technically feasible, cost-effective alternatives exist, the Trustees proceeded with identifying restoration alternatives that accomplish both primary and compensatory restoration for the injured resources discussed in Chapter 3.

The Trustees and Sunoco agreed to settle the NRDA damage claim for a total restoration amount of $1,148,000, which includes the Trustees' future project implementation cost. The following sections summarize the process the Trustees followed to identify restoration types appropriate to address injuries, identify potential restoration actions based on restoration type, and select a preferred restoration alternative.

4.2 Selection of Restoration Alternatives

The OPA and OSPRA regulations direct the Trustees to develop a reasonable range of restoration alternatives before selecting their preferred alternative(s). Each alternative must be designed so that, as a package of one or more actions, the preferred alternative would make the environment and public whole. Federal and Louisiana natural resource trustees established the RRP Program to help address incidents and assist in carrying out their NRDA responsibilities. The RRP Program helps in evaluation and selection of a preferred restoration alternative by assisting the natural resource trustees in identifying appropriate restoration types suitable to restore those trust resources and services injured, developing a list of potential restoration alternatives appropriate to restore injured trust resources and services, and selecting the preferred restoration alternative(s) to compensate the public for lost natural resources and services caused by each incident.

4.2.1 Relationship of the Injured Resources and Services to Restoration Types and Restoration Actions

As discussed in Chapter 2 of this Final DARP, the injured resources and services for this Incident are located in RRP Program Region 9. As such, the Trustees used inland and statewide resource and service injury categories described in Section 4.2.2.2 RRP Program FPEIS when applying various tools and selection criteria provided in the RRP Program to ensure the most suitable potential restoration actions were identified. Table 3.1 classifies the injured resource categories quantified by the Trustees for the Incident to the appropriate RRP Program injured resource and service category.

4.2.2 Restoration Type Identification and Selection

To streamline the process of developing a reasonable range of restoration alternatives for each RRP Program injured resource and service category, the Trustees first identified restoration types

suitable to address injuries caused by the Incident. Restoration types are identified in the RRP Program FPEIS and include the following seven broad categories:

1. Creation/enhancement of habitat;
2. Physical protection of habitat;
3. Acquisition/legal protection of resources and services;
4. Stocking of fauna;
5. Physical protection of fauna;
6. Restoration of recreational resource services; and
7. Restoration of cultural resource services.

The Trustees applied the nexus analysis, described in detail in Section 4.2.4.1 of the RRP Program FPEIS, to determine restoration types appropriate to restore injured resources and services caused by the Incident. As seen in Table 4.1, this resulted in a subset of appropriate restoration types that had a strong nexus to the injured natural resources and their services.

Next, the Trustees applied the restoration type selection criteria, described in Section 4.2.4.1.5 of the RRP Program FPEIS to the Wildlife injured resource category for this case. Restoration type screening assists the Trustees in determining which of the various restoration types with a strong nexus to the injured trust resources and services is most appropriate, or preferred, to restore injured trust resources and services caused by the Incident. These restoration type selection criteria are based in part on the OPA regulations (15 C.F.R. § 990.54(a)(1-6)) and include:

1. Strength of nexus;
2. Degree to which the restoration type addresses multiple injuries;
3. Scalability; and
4. Availability of projects for this restoration type in the RRP Program.

Through this process, the Trustees identified one preferred restoration type, Stocking Wildlife, for this case. Stocking Wildlife has a project available in the RRP Program and is able to provide resource specific restoration of the same type, quantity, and of comparable value as those lost for this case.

Preferred restoration type(s) for IFW, IUV and IBSS are not proposed at this time, as the Trustees are still evaluating habitat restoration project(s) to address these injuries. In the future, the Trustees will conduct a restoration type selection screening to identify preferred restoration type(s) and develop potential restoration project(s) to compensate the public for injuries to natural resources and services caused by this Incident.

Table 4.1 Inland restoration types by trust resources and services (a strong nexus is marked with a √ and indicates that a restoration type is an appropriate restoration alternative for the corresponding RRP Program injured trust resource or service; excerpted from NOAA et al. (2007)). Shaded cells note the inland restoration types appropriate for compensating for injuries to natural resources and services caused by the Incident.

INLAND			POTENTIALLY INJURED TRUST RESOURCES AND SERVICES								
			Herbaceous Wetlands	Forested Wetlands	Beaches/Shorelines/ Streambeds	Upland Vegetation	Water Column Org.	Birds	Wildlife	Recreation	Cultural
RESTORATION TYPES	Creation/ Enhancement of Habitat	Inland Herbaceous Wetlands	√				√	√	√	√	
		Inland Forested Wetlands		√			√	√	√	√	
		Inland Beaches/Shorelines/Streambeds			√		√	√	√	√	
		Inland Upland Vegetation				√	√	√	√	√	
	Physical Protection of Habitat	Inland Herbaceous Wetlands	√				√	√	√	√	
		Inland Forested Wetlands		√			√	√	√	√	
		Inland Beaches/Shorelines/Streambeds			√		√	√	√	√	
		Inland Upland Vegetation				√	√	√	√	√	
	Acquisition/ Legal Protection of Habitat	Inland Herbaceous Wetlands	√				√	√	√	√	
		Inland Forested Wetlands		√			√	√	√	√	
		Inland Beaches/Shorelines/Streambeds			√		√	√	√	√	
		Inland Upland Vegetation				√	√	√	√	√	
	Stocking of Fauna	Inland Water Column Org.					√			√	
		Birds						√		√	
		Wildlife							√	√	
	Physical Protection of Fauna	Birds						√		√	
		Wildlife							√	√	
	Recreational Resource Services									√	
	Cultural Resource Services										√

4.3 Identification of Potential Restoration Projects based on Restoration Type

Following the identification of the preferred restoration type for the wildlife injury, the Trustees conducted a screening of potential restoration projects or actions to develop the range and type of available restoration actions. Because all restoration actions contained in the RRP Program project database are grouped by restoration type and RRP Program Region, the Trustees were able to easily identify one preliminary restoration project that matched the Stocking Wildlife restoration type within RRP Program Region 9. Trustees identified the *United States Fish and Wildlife Service - Natchitoches National Fish Hatchery (USFWS – NNFH) Alligator Snapping Turtle Head-Start Project* (RRP Program Project ID# 2021-1036) which, based on restoration type, was potentially suitable to compensate the public for wildlife injuries caused by the Incident.

4.4 Selecting a Preferred Restoration Alternative

Following the identification of the potential restoration action(s), the Trustees used the Project Selection Screening Criteria as seen in Table 4.2 and described in Section 4.2.4.2 of the RRP Program FPEIS. The Project Selection Screening Criteria are based in part on the OPA regulations, Section 990.54[a][1-6] for the selection of specific restoration project(s). Only those actions considered technically feasible and in accordance with applicable laws, regulations, and/or permits were moved forward for further consideration by the Trustees.

Table 4.2 Restoration project selection screening criteria

Restoration Project Selection Screening Criteria	
OPA criteria	**RRP Program**
Cost to carry out each alternative	Project cost-effectiveness (including ability to partner)
The extent to which each alternative is expected to meet the trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses	Proximity to affected area
	Scalability
	Extent of benefit to injured trust resources and services
Likelihood of success of each alternative	Technical feasibility and likelihood of success
Extent to which each alternative will prevent future injury as a result of the Incident and avoid collateral injury as a result of implementing the alternative	Avoidance of future and additional injury resulting from the project
Extent to which each alternative benefits more than one natural resource and/or service	Degree to which the project addresses multiple injuries
Effect of each alternative on public health and safety	Degree to which project affects public health and safety
N/A	Ability to implement project with minimal delay
N/A	Degree to which project supports existing strategies/plans
N/A	Project urgency

Table 4.3 shows one (1) restoration action that met most or all of the criteria listed above and would meet the Trustees' goals to restore for lost natural resources and services caused by the Incident. This action was considered for further evaluation in the process of selecting a preferred alternative best suited for restoring the injured resources and making the environment and public whole.

Table 4.3 Restoration action considered for further evaluation

Restoration	**RRP Program Project #**	**Restoration Type**
USFWS - NNFH Alligator Snapping Turtle Head-Start Project	2021-1036	Stocking Wildlife

4.5 Evaluation of Potential Restoration Alternatives

4.5.1 No Action/Natural Recovery Alternative

Under this alternative, the Trustees would take no direct action to restore injured natural resources or compensate the public for lost services pending environmental recovery. Instead, the Trustees would rely on natural processes for recovery of the injured natural resources. The principal advantages of this approach are the ease of implementation and cost-effectiveness. However, the no action/natural recovery alternative is rejected for restoration because OPA and OSPRA clearly establish Trustee responsibility to seek compensation for interim losses pending recovery of the natural resources. Compensatory restoration cannot be addressed through a no-action alternative.

The Trustees' assessment of natural resource injuries indicates that losses occurred as a result of the Incident. Response actions undertaken may allow the injured resource to recover, but those actions would not compensate the public for the resource services lost over time. Such compensation serves to make the public and the environment whole. OPA and OSPRA provide for the public to be compensated for such losses based on actions that restore, replace, or provide services equivalent to those lost. As evidenced by the restoration alternative identified in Table 4.3, there are feasible and appropriate opportunities to restore, replace, or provide services equivalent to those lost due to the Incident. Under the no-action alternative, restoration actions needed to make the environment and public whole for its losses would not occur. This is inconsistent with the goals of the natural resource damages provisions of OPA and OSPRA. Thus, the Trustees determined that the no-action/natural recovery alternative (i.e., no restoration) should be rejected on that basis.

4.5.2 Preferred Alternative – USFWS - NNFH Alligator Snapping Turtle Head-Start Project

As discussed above, the Trustees identified one potential restoration action that was considered for further evaluation in the selection of a preferred restoration alternative.

The Trustees' restoration alternative evaluation focused on replacing lost fauna by facilitating additional production and repopulation of the alligator snapping turtle (AST), which has recently been proposed for listing as a threatened species under the Endangered Species Act. The Trustees chose to achieve this by prioritizing the replacement of essential species that are threatened or endangered, or are likely to become endangered in the foreseeable future. Given life history requirements of the turtle species injured (Table 3.4) and REAs calculated for representative species (Table 3.5), the Trustees determined for restoration planning, a requirement of 1,406.4 DTYs. In reviewing the potential project alternative, the USFWS - NNFH Alligator Snapping Turtle Head-Start Project stood out as providing the biological and geographic nexus to the injured species the Trustees desired. The USFWS - NNFH Alligator Snapping Turtle Head-Start Project would directly replace natural resources for those injured and provide comparable services in terms of wildlife production, providing a direct nexus to injured resources.

4.5.2.1 USFWS – NNFH Alligator Snapping Turtle Head-Start Project

The USFWS - NNFH Alligator Snapping Turtle Head-Start Project provides for the direct increase in the population of ASTs by raising and rearing approximately 600 hatchlings and releasing them into the environment. The AST is the largest freshwater turtle in North America and has experienced significant population declines throughout its range due to a host of factors, with pressures from unregulated historical commercial harvest and habitat loss being considered the species' principal threats (Sloan and Lovich 1995). ASTs are listed as Vulnerable by the International Union for Conservation of Nature (IUCN), under Appendix III of the Convention on International Trade in Endangered Species (CITES 2006; Tortoise and Freshwater Turtle Specialist Group 1996), and as a Species of Conservation Concern (S3) in the state of Louisiana (LDWF 2020b). More recently, the USFWS has proposed to list the AST as a threatened species under the Endangered Species Act, with a decision on the proposal to be rendered within one year. In response to the largely unregulated historical commercial harvest, significant numbers of reproductively mature animals were removed from Louisiana's statewide population. The removal of mature adults greatly limits the species recuperative ability, as ASTs, like most turtle species, have delayed sexual maturation (~11 years) and by their reproductive strategy (i.e., large clutch size) have significantly high juvenile mortality (Bass 2007; Holcomb and Carr 2011, 2013). This is in large part due to predation of nests and hatchlings, primarily by red imported fire ants (*Solenopsis invicta*) and raccoons (*Procyon lotor*). As one means of addressing the significant population decline of the AST, and these limiting factors on population recruitment, LDWF's Wildlife Diversity Program initiated a head-start program (a proven conservation tool in other turtle species) to strategically introduce older (3-4 years of age) ASTs, which have an increased chance of survival, within Louisiana drainages. The head-start program was initiated in 2012 at LDWF's hatchery facility in Monroe, LA to produce head-start turtles for release. Such

releases are an effective means of supplementing wild populations, helping to counterbalance low observed levels of natural recruitment.

The selected restoration action would provide a portion of the Sunoco settlement funds to the USFWS – NNFH head-start program to rear approximately 600 AST hatchlings, as 2 cohorts of hatchlings (600 hatchlings total), and then release the reared juveniles into their native habitats and monitor for a period of time. The project would be implemented by the USFWS - NNFH and employ similar approaches utilized by the LDWF head-start program as described above. Taking into consideration currently available information, the Trustees believe the project will be a cost-effective alternative for stocking wildlife given typical costs associated with these projects that continue to be implemented statewide by LDWF.

The project will result in a direct benefit to the injured resources by restoring ASTs through the reintroduction of the species into its native habitat. Stocking of ASTs would directly replace lost ASTs and is anticipated to provide similar or complementary ecological services to other wildlife, and therefore has a sufficient nexus to the injured resources. Such releases are an effective means of supplementing wild populations, helping to counterbalance low observed levels of natural recruitment and harvest pressures. These benefits would be sufficient to help compensate the public and the environment for ASTs and other wildlife injured during the Incident and provide both biological and geographic nexus to the injured resources. Given continued declines in the AST population across the state, existing ecological services related to the AST will continue to decrease over time and losses due to the Incident will not be offset if the project is not implemented.

The project is technically feasible and utilizes proven restoration techniques with established methods and documented results. The USFWS - NNFH’s head-start program has experience successfully rearing and releasing head-started juvenile ASTs into the natural environment. The project is currently awaiting funding and the Trustees foresee no delay in the implementation of the selected restoration action.

For the purposes of restoration scaling, the Trustees used a REA approach described above in Section 3.3 for the analysis of lost production. Turtle years were calculated based on literature-based assumptions and applications of animal age, annual survival, lifespan, and discounting. Other project-specific factors were also considered, including elapsed time from the onset of injury through the project life and time required for juvenile ASTs to grow and mature. The Trustees assumed project implementation in 2022, juvenile husbandry of 600 animals spanning approximately two years, age-related survival rates during husbandry and after release into the environment, and a 70-year lifespan (i.e., maximum attainable age). Based on these inputs and assumptions, the Trustees estimated that the project would offset a majority of the wildlife injury. In the future, to compensate the public for the remaining wildlife injury, the Trustees will conduct a restoration type screening to identify preferred restoration type(s) and fully describe and evaluate the potential restoration project(s) under OPA and OSPRA in a subsequent restoration plan that will be made available for public review and comment.

Performance monitoring would be performed to provide an assessment of project progress and help guide corrective actions, if any, to meet the project's goals and objectives. The project's success would be determined by comparing quantitative monitoring results to pre-determined performance standards developed by the Trustees defining minimum physical or structural conditions deemed to represent acceptable growth and development. Performance criteria and standards for the project would target hatchling success during husbandry. If the performance criteria are satisfied, then the Trustees are confident, based on previous experience, that the project will be successful and no further performance monitoring will be required. Should the performance criteria not be met, corrective action would be considered to remedy the situation. Potential corrective actions may include: husbandry of additional cohorts; monitoring for an additional period of time to see if the project begins to match anticipated trends; or other actions agreed upon by the Trustees that would correct the deficiency. After release into the environment, ASTs may also be monitored for a period of time. Monitoring would occur twice per month during the turtle's active season (March - October) and once per month during the inactive season (November - February). An annual recapture event would be implemented to assess individual health, body condition, growth, and to assess transmitter status (e.g., functioning appropriately or requiring replacement). Data generated would bolster the ability to more fully characterize post-release survival of head-start ASTs. For the reasons discussed above, the Trustees select the USFWS – NNFH Alligator Snapping Turtle Head-Start Project as one component of the preferred restoration alternative. The project would increase the population of ASTs by raising and rearing approximately 600 hatchlings, within indoor and outdoor facilities operated by USFWS - NNFH's head-start program, and releasing them into the environment as restoration for the Incident.

4.6 Summary of Preferred Restoration Alternative

As part of the cooperative assessment and Restoration Planning process, the Trustees evaluated expected benefits of potential restoration actions to identify a preferred restoration alternative that would address natural resource injuries resulting from the Incident. Based on the above information and analysis, the Trustees select the USFWS - NNFH Alligator Snapping Turtle Head-Start Project as one component of the preferred alternative to compensate the public for the injuries resulting from the Incident. This project would provide for the direct replacement of lost ASTs and similar or complementary ecological services to wildlife, through reintroduction of the species into its native habitat, ensuring that ecological services related to ASTs and other injured wildlife are restored. A portion of the settlement funds received from Sunoco would go towards USFWS - NNFH's head-start program to rear approximately 600 AST hatchlings, as two cohorts of hatchlings (600 hatchlings total), and then release the reared juveniles into their native habitats and monitor a subset of cohorts to inform data-driven management decisions. The project would be implemented by the USFWS - NNFH head-start program.

Restoration action(s) for mixed forest, bayhead swamp and aquatic habitat were not proposed at this time, as the Trustees are still evaluating habitat restoration project(s) to address these injuries. When suitable projects are identified, the Trustees will conduct a restoration type

selection screening to identify preferred restoration type(s) and fully describe and evaluate the potential restoration project(s) under OPA and OSPRA in a subsequent restoration plan that will be made available for public review and comment.

5 REFERENCES

Bass, A.A. 2007. Habitat Use and Movements of Alligator Snapping Turtle (*Macrochelys temminckii*) hatchlings [Unpublished Master of Science thesis]. University of Louisiana at Monroe: Monroe, LA.

Bazzaz, F.A. 1979. The Physiological Ecology of Plant Succession. Annual Review of Ecology and Systematics. 10:1. 351-371.

Belzer, B. 2002. A Nine Year Study of Eastern Box Turtle Courtship with Implications for Reproductive Success and Conservation in a Translocated Population. Turtle and Tortoise Newsletter. 6. 17-26.

Bowen, K.D., P.L. Colbert, and F.J. Janzen. 2004. Survival and Recruitment in a Human-Impacted Population of Ornate Box Turtles, *Terrapene ornata*, with Recommendations for Conservation and Management. Journal of Herpetology. 38(4). 562-568.

Buchman, A.B., J.C. Cureton II, W.I. Lutterschmidt, and E.D. Wilson. 2010. Seasonal Occurrence of Activity and Reproduction of the Three-Toed Box Turtle (*Terrapene carolina triunguis*) in East Texas. BIOS. 81(3). 84-90.

Budischak, S.A., J.M. Hester, S.J. Price, and M.E. Dorcas. 2006. Natural History of *Terrapene carolina* (Box Turtles) in an Urbanized Landscape. Southeastern Naturalist. 5(2). 191-204.

Central Louisiana Regional Port (CLRP). 2015. Red River's Gateway to Economic Development. Accessed November 19, 2021 at: https://clrport.com/

CITES (Convention on International Trade in Endangered Species). 2006. Appendix III. Accessed February 15, 2022 at: https://cites.org/eng/app/appendices.php

Daigle, J.J., G.E. Griffith, J.M. Omernik, P.L. Faulkner, R.P. McCulloh, L.R. Handley, L.M. Smith, and S.S. Chapman. 2006. Ecoregions of Louisiana (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,000,000).

Dundee, H.A. and D.A. Rossman. 1989. The Amphibians and Reptiles of Louisiana. Baton Rouge: Louisiana State University Press. 300 pp.

Ernst, C.H.1986. Ecology of the turtle, *Sternotherus odoratus*, in southeastern Pennsylvania. Journal of Herpetology. 20(3). 341-352.

Ernst, C.H. and J.E. Lovich. 2009. Turtles of the United States and Canada. 2nd ed. Baltimore: John Hopkins University Press. 827 pp.

Gibbons, J.W. 1990. Life History and Ecology of the Slider Turtle. Washington, DC: Smithsonian Institution Press.

Greene, R., and E. Brasher. 2020. Louisiana 2020 Forest Action Plan: A Statewide Forest Resource Assessment and Strategy. Baton Rouge, LA: Louisiana Department of Agriculture and Forestry, Office of Forestry. 74 pp.

Groninger, J.W. and M.A. Long. 2008. Oak Ecosystem Management Considerations for Central Hardwoods Stands Arising from Silvicultural Clearcutting. Northern Journal of Applied Forestry. 25(4). 173-179.

Harlow, W.M., and E.S. Harrar. 1969. Textbook of Dendrology. Fifth edition. McGraw Hill, New York. 512 pp.

Hicks, R. R., Jr., W.H. Conner, R.C. Kellison, and D.Van Lear. 2004. Silviculture and Management Strategies Applicable to Southern Hardwoods. In Southern Forest Science: Past, Present and Future. Rauscher, H. M. and Johnsen, K, eds. USDA Forest Service GTR SRS-75. 51-62.

Holcomb, S.R., A.A. Bass, C.S. Reid, M.A. Seymour, N.F. Lorenz, B.B. Gregory, S.M. Javed, and K.F. Balkum. 2015. Louisiana Wildlife Action Plan. Louisiana Department of Wildlife and Fisheries. Baton Rouge, Louisiana. 705 pp.

Holcomb, S.R. and J.L. Carr. 2011. Hatchling Emergence from Naturally Incubated Alligator Snapping Turtle (*Macrochelys temminckii*) Nests in Northern Louisiana. Chelonian Conservation and Biology. 10(2). 22-7.

Holcomb, S.R. and J.L. Carr. 2013. Mammalian Depredation of Artificial Alligator Snapping Turtle (*Macrochelys temminckii*) Nests in North Louisiana. Southeastern Naturalist 12(3). 478-491.

Jordan, D., F. Ponder Jr., and V.C. Hubbard. 2003. Effects of soil compaction, forest leaf litter and nitrogen fertilizer on two oak species and microbial activity. Applied Soil Ecology. 23. 33-41.

Ligon, D.B. and M.B. Lovern. 2009. Temperature Effects During Early Life Stages of the Alligator Snapping Turtle (*Macrochelys temminckii*). Chelonian Conservation and Biology. 8(1). 74-83.

Lindeman, P.V. 2008. *Sternotherus carinatus* (Gray 1856) – Razorback Musk Turtle, Razor-Backed Musk Turtle. In: Rhodin, A.G.J., Pritchard, P.C.H., van Dijk, P.P., Saumure, R.A., Buhlmann, K.A., and Iverson, J.B. (Eds.). Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelonian Research Monographs. 5. 012.1-012.6.

Loehle, C. 1987. Tree Life History Strategies: The Role of Defenses. Canadian Journal of Forestry Research. 18(2). 209-222.

Louisiana Department of Environmental Quality (LDEQ). n.d. Louisiana Department of Environmental Quality Interactive Map. Accessed 12/10/2021 at: https://deq.louisiana.gov/index.cfm?md=resource&tmp=category&catid=make-a-map

Louisiana Department of Environmental Quality (LDEQ). 2020. Louisiana Water Quality Inventory: Integrated Report. 202 pp.

Louisiana Department of Wildlife and Fisheries (LDWF). n.d. Protecting Wildlife Diversity. Accessed February 23, 2022 at: https://www.wlf.louisiana.gov/page/wildlife-diversity

Louisiana Department of Wildlife and Fisheries (LDWF). 2020a. LDWF Geospatial Data Repository. Accessed November 22, 2021 at: https://ldwf-geospatial-gateway-ldwf.hub.arcgis.com/

Louisiana Department of Wildlife and Fisheries (LDWF). 2020b. Wildlife Diversity Program. Louisiana's Species of Greatest Conservation Need and Natural Communities. 7 pp.

Louisiana Division of the Arts, 2019. Office of Cultural Tourism, Dept. of Culture, Recreation & Tourism. Louisiana Folklife Program. Accessed November 15, 2021 at: https://www.louisianafolklife.org/main_credits.html#tab

Louisiana Office of Indian Affairs. n.d. Office of the Governor. Accessed February 23, 2022 at: https://gov.louisiana.gov/page/indian-affairs

Louisiana Office of Tourism & Office of the Lt. Governor. 2021. Preserving and Showcasing Louisiana's Natural and Historical Treasures. Accessed November 22, 2021 at: https://www.lastateparks.com/

Miller, J.K. 2001. Escaping senescence: demographic data from the three-toed box turtle (*Terrapene carolina triunguis*). Experimental Gerontology. 36(4–6). 829-832.

Mitchell, J.C. 1988. Population ecology and life histories of the freshwater turtles *Chrysemys picta* and *Sternotherus odoratus* in an urban lake. Herpetological Monographs. 2(40-61).

National Oceanic and Atmospheric Administration (NOAA). 1997. Scaling Compensatory Restoration Actions: Guidance Document for Natural Resource Damage Assessment Under the Oil Pollution Act of 1990. Washington DC: National Oceanic and Atmospheric Administration: Damage Assessment and Restoration Program. 143 pp.

National Oceanic and Atmospheric Administration (NOAA). 1999. Discounting and the treatment of uncertainty in natural resource damage assessment. Technical Paper 99-1. National Oceanic and Atmospheric Administration, Damage Assessment and Restoration Program, Silver Spring, MD. 43 pp.

National Oceanic and Atmospheric Administration (NOAA). 2000. Habitat Equivalency Analysis: an overview. Damage Assessment and Restoration Program, U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Silver Spring, Maryland. 23 pp.

National Oceanic and Atmospheric Administration (NOAA). 2021. National Centers for Environmental Information, Climate at a glance: Global Mapping. Accessed December 14, 2021 at: https://www.ncdc.noaa.gov/cag/global/mapping

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2022. National ESA Critical Habitat Mapper. Accessed April 27, 2022 at: https://www.fisheries.noaa.gov/resource/map/national-esa-critical-habitat-mapper

National Oceanic and Atmospheric Administration, U.S. Department of the Interior, Louisiana Oil Spill Coordinator's Office, Office of the Governor, Louisiana Department of Environmental Quality, Louisiana Department of Natural resources, Louisiana Department of Wildlife and Fisheries. 2007. The Louisiana Regional Restoration Planning Program Final Programmatic Environmental Impact Statement. 172 pp plus appendices.

National Park Service. n.d. National Register of Historical Places Accessed November 17, 2021 at: https://www.nps.gov/subjects/nationalregister/database-research.htm

Natural Resources Conservation Service (NRCS). 2006. United States Department of Agriculture. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. 682 pp.

Newton, M.B. 1972. Atlas of Louisiana: a Guide for Students. Miscellaneous Publication 72-1. School of Geoscience, Louisiana State University, Baton Rouge, Louisiana.

Oliver, C.D and B.A. Larson. 1996. Forest Stand Dynamics, Update Edition. FES Other Publications. 1. https://elischolar.library.yale.edu/fes_pubs/1

Reed, R.N., J.D. Congdon, and J.W. Gibbons. 2002. The Alligator Snapping Turtle (*Macrochelys temminckii*): A Review of Ecology, Life History, and Conservation, with Demographic Analyses of the Sustainability of Take from Wild Populations. Savannah River Ecology Lab: Aiken, South Carolina. 20 pp.

Sloan, K, and J. Lovich, 1995. Exploitation of the Alligator Snapping Turtle, *Macroclemys temminckii*, in Louisiana: A case study. Chelonian Conservation and Biology 1(3). 221-222.

Sperduto, M.B., S.P. Powers, and M. Donlan. 2003. Scaling restoration to achieve quantitative enhancement of loon, seaduck, and other seabird populations. Marine Ecology Progress Series 264. 221-232.

Steyermark, A.C., M.S. Finkler, and R.J. Brooks. 2008. Biology of the Snapping Turtle (*Chelydra Serpentina*). Baltimore, NJ: The John Hopkins University Press.

Stuart, C. G., D. Knochenmus, and B.D. McGee. 1994. Guide to Louisiana's ground water resources: U.S. Geological Survey, Baton Rouge, LA, prepared in cooperation with Louisiana Department of Transportation and Development, Baton Rouge, LA, Water Resources Investigations Report 94-4085. 55 pp.

Tinkle, D.W. 1961. Geographic Variation in Reproduction, Size, Sex Ratio and Maturity of *Sternothaerus odoratus* (Testudinata: Chelydridae). Ecology. 42(1). 68-76.

Tortoise & Freshwater Turtle Specialist Group. 1996. *Macrochelys temminckii*. The IUCN Red List of Threatened Species 1996: e.T12589A97272309. http://dx.doi.org/10.2305/IUCN.UK.1996.RLTS.T12589A3362355.en

United States Army Corps of Engineers (USACE). n.d. Vicksburg District Website/Missions/Recreation. Accessed December 6, 2021 at: https://www.mvk.usace.army.mil/Missions/Recreation/

United States Army Corps of Engineers (USACE). 2021. Waterborne Commerce of the United States, Calendar Year 2019, Part 5 - National Summaries. June 14, 2021. 99 pp.

United States Census Bureau. n.d. QuickFacts for Louisiana and Caddo Parish. Accessed November 15, 2021 at: https://www.census.gov/quickfacts/fact/table/caddoparishlouisiana,LA/PST045219

United States Census Bureau. 2021. Tiger/Line Geodatabases. Accessed November 17, 2021 at: https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-geodatabase-file.html

United States Department of Agriculture (USDA). n.d. Forest Service. Kisatchie National Forest GIS Data. Accessed December 10, 2021 at: https://www.fs.usda.gov/detail/kisatchie/maps-pubs/?cid=fsbdev3_024681

United States Department of Agriculture (USDA). 2019a. Census of Agriculture 2017 State and Parish Profiles. Accessed December 7, 2021 at: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Louisiana/index.php

United States Department of Agriculture (USDA). 2019b. Kisatchie Ranger District, Kisatchie National Forest. 2 pp.

United States Department of Agriculture (USDA). 2019c. Catahoula Ranger District, Kisatchie National Forest. 2 pp.

United States Department of Transportation (US DOT). 2020. Bureau of Transportation Statistics. Geospatial at BTS. Accessed November 17, 2021 at: https://data-usdot.opendata.arcgis.com/

United States Fish and Wildlife Service (USFWS). n.d. Natchitoches National Fish Hatchery. Accessed May 5, 2022 at: https://www.fws.gov/fish-hatchery/natchitoches

United States Fish and Wildlife Service (USFWS). 2020. Endangered, Threatened, and Candidate Species of Louisiana. Accessed November 6, 2020 at: https://www.fws.gov/southeast/pdf/fact-sheet/louisiana-ecological-services-field-office-t-and-e-species.pdf

United States Fish and Wildlife Service (USFWS). 2022. Environmental Conservation Online System. Accessed April 27, 2022 at: https://ecos.fws.gov/ecp/report/critical-habitat

University of New Orleans Hospitality Research Center. 2019. Tourism Spending in Louisiana Parishes 2018. Prepared for Louisiana Department of Culture, Recreation, and Tourism. 25 pp.

Webster, C.R., M.A. Jenkins, and J. Shibu. 2006. Woody Invaders and the Challenges they Pose to Forest Ecosystems in the Eastern United States. Journal of Forestry Oct/Nov 2006. 366-374.

Weindorf, D. C. 2008. An Update of the Field Guide to Louisiana Soil Classification. Research Bulletin no. 889. Louisiana State University Agricultural Center, Louisiana State University, Baton Rouge, Louisiana. 40 pp.

APPENDICES

APPENDIX A LIST OF ACRONYMS

AR	Administrative Record
AST	Alligator Snapping Turtle
CITES	Convention on International Trade in Endangered Species
CLRP	Central Louisiana Regional Port
CPRA	Coastal Protection and Restoration Authority
DARP	Damage Assessment and Restoration Plan
DSAY	Discounted Service Acre Year
DTY	Discounted Turtle-Year
FPEIS	Final Programmatic Environmental Impact Statement
HEA	Habitat Equivalency Analysis
IBSS	Inland Beaches/Shorelines/Streambeds
IFW	Inland Forested Wetland
IUCN	International Union for Conservation of Nature
IUV	Inland Upland Vegetation
KNF	Kisatchie National Forest
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDWF	Louisiana Department of Wildlife and Fisheries
LOSCO	Louisiana Oil Spill coordinator’s Office
NNFH	Natchitoches National Fish Hatchery
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment
NRHP	National Register of Historic Places
OPA	Oil Pollution Act
OSPRA	Oil Spill Prevention and Response Act
REA	Resource Equivalency Analysis

RP	Responsible Party
RRP Program	Regional Restoration Planning Program
US DOT	United States Department of Transportation
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

APPENDIX B COMMON BIOTA AND ASSOCIATED HABITATS IN REGION 9

Table B-1: Common Vegetation in Region 9 and their Associated Habitats

Scientific Name	Common Name	Habitats (see Table B-11 for key)
Phragmites spp.	common reeds, roseau cane	FM, B/IM
Typha spp.	cattails	FM
Zizaniopsis miliacea	giant cutgrass	FM
Panicum hemitomon	maidencane	FM
Cladium jamaicense	saw grass	FM
Eleocharis spp.	spike-rushes	FM
Pontederia cordata	pickerelweed	FM
Sagittaria spp.	arrowheads	FM
Salix nigra	black willow	FM, WF, B
Quercus spp.	oaks	WF, UF
Liquidambar styraciflua	sweet gum	WF, UF
Nyssa spp.	gums, tupelos	WF
Acer rubrum	red maple	WF, UF
Taxodium distichum	bald cypress	WF
Ulmus americana	American elm	WF
Fraxinus spp.	ashes	WF, UF
Liriodendron tulipifera	tulip poplar	WF
Platanus occidentalis	sycamore	WF
Cephalanthus occidentalis	buttonbush	WF
Carya spp.	hickory	UF
Pinus palustris	longleaf pine	UF
Pinus echinata	shortleaf pine	UF
Potamogeton spp.	pondweed	M/ESAV, FSAV
Ceratophyllum demersum	coontail	FSAV
Utricularia spp.	bladder worts	FSAV
Eichhornia crassipes	water hyacinth	FSAV
Alternanthera philoxeroides	alligatorweed	FSAV
Limnobium spongia	American frog-bit	FSAV
Pistia stratiotes	water lettuce	FSAV
Nymphaea odorata	white water lily	FSAV
Hydrilla verticillata	hydrilla	FSAV

Table B-2: Common Mammals in Region 9 and their Associated Habitats

Scientific Name	Common Name	Habitats (see Table B-11 for key)
Odocoileus virginianus	whitetail deer	B/IM, FM, WF, B, WS/S, UF, A/C/G, US/S, FS
Sylvilagus spp.	swamp rabbit, eastern cottontail	B/IM, FM, WF, B, WS/S, UF, A/C/G, US/S
Myocastor coypus	nutria	B/IM, FM, WF, B, WS/S, FS
Ondatra zibethica	muskrat	B/IM, FM, WF, B, WS/S, FS
Procyon lotor	raccoon	B/IM, FM, WF, B, WS/S, UF, US/S, FS, M/ES, A/C/G
Sus scrofa	wild boar	FM, WF, B, UF, WS/S, US/S
Reithrodontomys fulvescens	fulvous harvest mouse	SM, B/IM, FM, WF, B, UF, MS, A/C/G, WS/S, US/S, FS, M/ES
Dasypus novemcinctus	armadillo	WF, B, UF, A/C/G, WS/S, US/S
Canis latrans	coyote	UF, A/C/G, WF, B, WS/S, US/S
Lynx rufus	bobcat	WF, B, UF, US/S
Didelphis virginiana	Virginia opossum	UF, A/C/G, WF, B, WS/S, US/S
Lasiurus borealis	eastern red bat	WF, UF
Sciurus carolinensis	eastern grey squirrel	UF, US/S
Sciurus niger	fox squirrel	UF, US/S
Mustela vison	mink	B/IM, FM, FS, M/ES, W
Lutra canadensis	river otter	B/IM, FM, WF, B, WS/S, FS

Table B-3:Common Reptiles and Amphibians in Region 9 and their Associated Habitats

Scientific Name	Common Name	Habitats (see Table B-11 for key)
Alligator mississippiensis	American alligator	SM, B/IM, FM, WF, B, MS, M/ESAV, FSAV, M/EB, FB
Chelydra serpentina	snapping turtle	B/IM, FM, M/ES, FS, WF, B, M/ESAV, FSAV, M/EB, FB
Sternotherus spp.	musk turtles	FM, FS, WF, B, FSAV, FB
Kinosternon spp.	mud turtles	B/IM, M/ES, FM, FS, WF, B, FSAV, M/ESAV, M/EB, FB
Graptemys psuedogeographica kohnii	Mississippi map turtle	FM, FS, WF, B, FSAV, FB
Deirochelys reticularia	chicken turtle	FM, FS, WF, B, FSAV, FB
Chrysemys picta	painted turtle	FM, FS, WF, B, FSAV, FB
Pseudemys concinna	river cooter (turtle)	FM, FS, WF, B, FSAV, FB
Trachemys scripta	slider (turtle)	FM, FS, WF, B, FSAV, FB
Terrapene spp.	box turtles	WF, B, UF, A/C/G, WS/S, US/S, FS,
Apalone spp.	softshell turtles	FM, FS, WF, B, FSAV, FB
Nerodia spp.	water snakes	SM, B/IM, M/ES, M/ESAV, FM, FS, WF, B, FSAV
Regina spp.	crawfish snakes	FM, FS, WF, B, FSAV, A/C/G, WS/S
Thamnophis spp.	garter, ribbon snakes	FM, FS, WF, B, FSAV, UF, A/C/G, US/S, WS/S
Storeria spp.	redbelly, brown snakes	FM, FS, FSAV, WF, B, UF, A/C/G, US/S, WS/S
Virginia spp.	earth snakes	FM, FS, FSAV, WF, B, UF, A/C/G, US/S, WS/S
Diadophis punctatus	ringneck snake	WF, B, UF, A/C/G, US/S, WS/S, FS
Heterodon platirhinos	eastern hognose snake	WF, B, UF, A/C/G, US/S, WS/S, FS
Opheodrys aestivus	rough green snake	WF, B, UF, A/C/G, US/S, WS/S, FS, FM
Farancia abacura	mud snake	SM, B/IM, M/ES, M/ESAV, FM, FS, WF, B, FSAV
Coluber constrictor	racer (snake)	WF, B, FM, FS, WS/S
Elaphe spp.	rat snakes	UF, A/C/G, WF, B, US/S, WS/S
Lampropeltis spp.	milk snakes, kingsnakes	B/IM, M/ES, FM, FS, WF, B, UF, A/C/G, WS/S, US/S
Agkistrodon piscivorus	cottonmouth (snake)	B/IM, M/ES, FM, FS, WF, B, WS/S
Agkistrodon contortrix	copperhead (snake)	FS, WF, B, US/S, WS/S, A/C/G, UF
Sistrurus miliarius	pigmy rattlesnake	FS, WF, B, WS/S, US/S, A/C/G, UF
Crotalus horridus	timber rattlesnake	FS, WF, B, WS/S, US/S, A/C/G, UF
Scincella lateralis	ground skink	WF, WS/S, UF, B, A/C/G, FS, M/ES, US/S, UB
Hyla spp.	tree frogs	B/IM, M/ES, M/ESAV, FM, FS, FSAV, WF, B, WS/S
Psuedacris spp.	chorus frogs	B/IM, M/ES, M/ESAV, FM, FS, FSAV, WF, B, WS/S, A/C/G
Acris spp.	cricket frogs	B/IM, M/ES, M/ESAV, FM, FS, FSAV, WF, B, WS/S, A/C/G
Rana spp.	true frogs	B/IM, M/ES, M/ESAV, FM, FS, FSAV, WF, B, WS/S, US/S, A/C/G, UF

Table B-4: Common Birds in Region 9 and their Associated Habitats - Waterfowls and Waterbirds

Scientific Name	Common Name	Season*	Habitats (see Table B-11 for key)
Gavia immer	common loon	W	M/ES, FS, M/ESAV, FSAV, W
Podiceps spp.	grebes	W	M/ES, M/ESAV, W
Phalacrocorax auritus	double-crested cormorant	W	M/ES, M/ESAV, FS, FSAV, W
Anhinga anhinga	American anhinga	YR	WF, B, A/C/G, FS, WS/S, W
Chen caerulescens	snow goose	W	M/ES, FS, B/IM, FM, A/C/G, W
Branta canadensis	Canada goose	W	M/ES, FS, B/IM, FM, A/C/G, W
Anas fulvigula	mottled duck	YR	B/IM, M/ES, FM, FS, M/ESAV, FSAV, W
Anas strepera	gadwall	W	B/IM, M/ES, FM, FS, M/ESAV, FSAV, W
Anas platyphynchos	mallard	W	B/IM, M/ES, FM, FS, M/ESAV, FSAV, WF, B, WS/S, W
Anus acuta	common pintail	W	SM, B/IM, M/ES, FM, FS, M/ESAV, FSAV, W
Anus americana	American wigeon	W	B/IM, M/ES, FM, FS, M/ESAV, FSAV, A/C/G, W
Aix sponsa	wood duck	YR	WF, WS/S, FS, B, W
Anas clypeata	northern shoveler	W	FM, FS, FSAV, SM, B/IM, M/ES, M/ESAV, W
Anas discors	blue-winged teal	YR	FM, FS, FSAV, W
Anas crecca	green-winged teal	W	M/ES, B/IM, FM, FS, FSAV, W
Aythya valisineria	canvasback	W	SM, B/IM, FM, M/ES, FS, M/ESAV, FSAV, W
Aythya collaris	ring-necked duck	W	WF, WS/S, FS, B, W
Aythya affinis	lesser scaup	W	FS, FSAV, M/ES, W
Bucephala clangula	common goldeneye	W	WF, WS/S, FS, W, B, M/ES
Bucephala albeola	bufflehead	W	FS, FSAV, M/ES, M/ESAV, W
Oxyura jamaicensis	ruddy duck	W	FS, FM, FSAV, M/ES, W
Mergus serrator	red-breasted merganser	W	FS, M/ES, FSAV, W
Gelochelidon nilotica	gull-billed tern	YR	SM, M/ES, WB, A/C/G, W, B/IM
Lophodytes cucullatus	hooded merganser	W, Br	WF, WS/S, B, FS, W
Fulica americana	American coot	W	W, FM, B/IM, FS, M/ES, A/C/G, M/ESAV, FSAV
Gallinula chloropus	common moorhen	YR	W, FM, FS, FSAV
Porphyrula martinica	purple gallinule	Br	W, FM, FS, WF, B, FSAV

*Br = present during breeding season (generally spring and/or summer)
W = present in winter
YR = present year round

Table B-5: Common Birds in Region 9 and their Associated Habitats - Fowl

Scientific Name	Common Name	Season*	Habitats (see Table B-11 for key)
Meleagris gallopavo	wild turkey	YR	WF, B, UF, WS/S, US/S
Colinus virginianus	common bobwhite	YR	A/C/G, US/S, UF, WF

*Br = present during breeding season (generally spring and/or summer)
W = present in winter
YR = present year round

Table B-6: Common Birds in Region 9 and their Associated Habitats – Colonial Nesting Wading Birds

Scientific Name	Common Name	Season*	Habitats (see Table B-11 for key)
Ardea herodias	great blue heron	YR	FM, B/IM, SM, WB, FS, M/ES, WF, MS, B, WS/S, W
Egretta caerulea	little blue heron	YR	FM, B/IM, SM, WB, WF, MS, B, WS/S, A/C/G, W, FS, ME/S
Hydranassa tricolor	tricolored heron	YR	FM, B/IM, SM, WB, WF, MS, B, WS/S, W, FS, ME/S
Casmerodius albus	great egret	YR	FM, B/IM, SM, WB, WF, W, FS, ME/S, WF, FS, M/ES
Egretta thula	snowy egret	YR	FM, B/IM, SM, WB, WF, MS, B, WS/S, W, FS, M/ES
Bubulcus ibis	cattle egret	YR	FM, WB, W, A/C/G, FS
Nycticorax nycticorax	black-crowned night heron	YR	FM, B/IM, SM, WB, WF, MS, B, WS/S, W, FS, M/ES
Nyctanassa violacea	yellow-crowned night heron	Br	FM, B/IM, SM, WB, WF, MS, B, WS/S, W, FS, M/ES
Butorides striatus	green-backed heron	YR	FM, B/IM, SM, WB, WF, MS, B, WS/S, W, FS, M/ES
Ixobrychus exilis	least bittern	Br	FM, FS, W
Botaurus lentiginosus	American bittern	W	FM, FS, W
Eudocimus albus	white ibis	YR	FM, B/IM, SM, WB, WF, MS, B, WS/S, W, FS, M/ES, A/C/G
Rallus spp.	rails	W, Br	FM, B/IM, SM, WB, WF, MS, B, WS/S, W, FS, M/ES
Himantopus mexicanus	black-necked stilt	YR	FM, FS, W, WB
Recurvirostra americana	American avocet	W	M/ES, FS, W
Pluvialis squatarola	black-bellied plover	W	FS, WB, ME/S, W
Arenaria interpres	ruddy turnstone	W	FS, WB, ME/S, W, WS/S
Charadrius vociferous	killdeer	YR	A/C/G, FS, WS/S, W
Philohelo minor	American woodcock	W	WS/S, WF, B
Capella gallinago	common snipe	W	WB, FM, B/IM, A/C/G
Limnodromus griseus	short-billed dowitcher	W	WB, FM, B/IM, FS
Calidris canutus	red knot	W	M/ES, FS
Catoptrophorus semipalmatus	willet	YR	FM, B/IM, SM, M/ES, WB
Tringa melanoleuca	greater yellowlegs	W	FM, WB, FS, W, B, WF, WS/S
Tringa flavipes	lesser yellowlegs	W	FM, WB, FS, W, WF, WS/S, M/ES, B/IM, SM
Calidris alba	sanderling	W	FS, M/ES
Calidris alpine	dunlin	W	WB, M/ES, FS
Actitus macularia	spotted sandpiper	W	WS/S, FS
Calidris minutilla	least sandpiper	W	WB, FM, W, FS
Calidris mauri	western sandpiper	W	WB, M/ES, FS

*Br = present during breeding season (generally spring and/or summer)
W = present in winter
YR = present year round

Table B-7: Common Birds in Region 9 and their Associated Habitats – Raptors

Scientific Name	Common Name	Season*	**Habitats (see Table B-11 for key)**
Ictinia mississippiensis	Mississippi kite	Br	WF, B, WS/S
Accipiter striatus	sharp-shinned hawk	W	WF, UF, B, WS/S, US/S
Accipiter cooperii	Cooper's hawk	YR	WF, UF, B, WS/S, US/S
Circus cyanus	northern harrier	W	FM, B/IM, A/C/G
Buteo jamaicensis	red-tailed hawk	YR	A/C/G, WF, B, UF, FM, WS/S
Buteo lineatus	red-shouldered hawk	YR	A/C/G, WF, B, UF, FM, WS/S
Buteo platypterus	broad-winged hawk	Br	WF, UF, B
Haliaeetus leucocephalus	bald eagle	Br	WF, UF
Pandion haliaetus	osprey	YR	WF, FS, M/ES
Cathartes aura	turkey vulture	YR	WF, UF
Coragyps atratus	black vulture	YR	WF, UF
Falco sparverius	American kestrel	W	A/C/G, WF, UF
Falco columbarius	merlin	W	UF, WF, FM, A/C/G
Falco peregrinus	peregrine falcon	W	A/C/G
Otus asio	eastern screech owl	YR	WF, UF, A/C/G, US/S, WS/S, B
Bubo virginianus	great horned owl	YR	WF, UF, WS/S, US/S, A/C/G

*Br = present during breeding season (generally spring and/or summer)
W = present in winter
YR = present year round

Table B-8: Common Birds in Region 9 and their Associated Habitats - Non-Passerine Land Birds

Scientific Name	Common Name	Season*	**Habitats (see Table B-11 for key)**
Zenaida macroura	mourning dove	YR	A/C/G, UF, US/S
Coccyzus americanus	yellow-billed cuckoo	Br	UF, US/S, A/C/G
Chordeiles minor	common nighthawk	Br	A/C/G, UF
Caprimulgus carolinensis	chuck-will's-widow	Br	WF, UF, WS/S, US/S, B
Archilochus colubris	ruby-throated hummingbird	Br	A/C/G, UF
Megaceryle alcyon	belted kingfisher	W	FS, M/ES, W, FM, B/IM, SM
Melanerpes erythrocephalus	red-headed woodpecker	YR	A/C/G, UF, US/S
Dryocopus pileatus	pileated woodpecker	YR	UF, WF
Colaptes auratus	common flicker	YR	UF, WF, A/C/G
Melanerpes carolinus	red-bellied woodpecker	YR	WF, UF, A/C/G
Sphyrapicus varius	yellow-bellied sapsucker	W	WF, UF,
Picoides pubescens	downy woodpecker	YR	WF, UF, B, WS/S, US/S
Picoides villosus	hairy woodpecker	YR	WF, UF, B, WS/S, US/S

*Br = present during breeding season (generally spring and/or summer)
W = present in winter
YR = present year round

Table B-9: Common Birds in Region 9 and their Associated Habitats - Passerine Birds

Scientific Name	Common Name	Season*	**Habitats (see Table B-11 for key)**
Tyrannus tyrannus	eastern kingbird	Br	UF, WF, WS/S, A/C/G
Muscivora forficata	scissor-tailed woodpecker	W, Br	A/C/G
Myiarchus crinitus	great crested flycatcher	Br	UF, WF
Contopus virens	eastern pewee	Br	UF, WF, WS/S, US/S
Empidonax virescens	acadian flycatcher	Br	UF, WF, B
Anthus spinoletta	water pipit	W	FS, M/ES, A/C/G
Progne subis	purple martin	Br	FS, A/C/G
Hirundo rustica	barn swallow	Br	A/C/G, FM, FS, W
Iridoprocne bicolor	tree swallow	W	A/C/G, FS, WB, FM, WF
Stelgidopteryx ruficollis	rough-winged swallow	Br	FS, WS/S, FM
Corvus ossifragus	fish crow	YR	FS, A/C/G, M/ES
Corvus brachyrhynchos	American crow	YR	UF, WF, A/C/G, WS/S, FS
Cyanocitta cristata	blue jay	YR	UF, A/C/G
Parus carolinensis	Carolina chickadee	YR	UF, A/C/G
Parus bicolor	tufted titmouse	YR	WF, UF, A/C/G
Certhia familiaris	brown creeper	W	WF, UF, WS/S, US/S
Troglodytes aedon	house wren	W	A/C/G, US/S, UF
Troglodytes troglodytes	winter wren	W	UF
Thryothorus ludovicianus	Carolina wren	YR	A/C/G, US/S
Cistothorus platensis	sedge wren	W	A/C/G, FM
Regulus satrapa	golden-crowned kinglet	W	UF, WF
Regulus calendula	ruby-crowned kinglet	W	UF, WF
Polioptila caerulea	blue-gray gnatcatcher	YR, Br	UF, WF, US/S, WS/S
Toxostoma rufum	brown thrasher	YR	US/S, WS/S
Dumetella carolinensis	gray catbird	W, YR	US/S, WS/S, A/C/G
Mimus polyglottos	northern mockingbird	YR	US/S, UF, A/C/G
Sialia sialis	eastern bluebird	YR	A/C/G, US/S, WS/S
Turdus migratorius	American robin	W	A/C/G, UF
Catharus guttatus	hermit thrush	W	UF, WF, US/S, WS/S, A/C/G
Hylocichla mustelina	wood thrush	Br	UF, WF
Lanius ludovicianus	loggerhead shrike	YR	A/C/G
Bombycilla cedrorum	cedar waxwing	W	UF, WF, US/S, A/C/G
Vireo spp.	vireos	Br, W, YR	UF, US/S, UB
Protonotaria citrea	prothonotary warbler	Br	WF, B, WS/S
Parula americana	northern parula warbler	Br	WF, B
Dendroica dominica	yellow-throated warbler	YR, Br	UF
Mniotilta varia	black-and-white warbler	W, Br	UF
Setophaga ruticilla	American redstart	Br	UF, US/S
Limnothlypis swainsonii	Swainson's warbler	Br	WF, OS, WB, WS/S
Helmitheros vermivorus	worm-eating warbler	Br	UF, US/S, UB
Dendroica coronata	yellow-rumped warbler	W	UF, WF, US/S, WS/S
Dendroica pinus	pine warbler	YR	UF
Dendroica discolor	prairie warbler	Br	US/S
Dendroica palmarum	palm warbler	W	A/C/G, UF, US/S
Vermivora celata	orange-crowned warbler	W	US/S
Wilsonia pusilla	Wilson's warbler	W	WS/S, B
Wilsonia citrina	hooded warbler	Br	WF, B, WS/S
Oporornis philidelphia	Kentucky warbler	Br	A/C/G, UB, US/S
Geothlypis trichas	common yellowthroat	YR	FW, B, FM, WS/S
Icteria virens	yellow-breasted chat	Br	WS/S, US/S
Seiurus aurocapillus	ovenbird	W	UF, US/S
Agelaius phoeniceus	red-winged blackbird	YR	FM, WF, B, A/C/G, FS, WS/S
Molothrus ater	brown-headed cowbird	YR	A/C/G, WS/S, WF, US/S, UF
Euphagus carolinus	rusty blackbird	W	WS/S, WF, B
Euphagus cyanocephalus	Brewer's blackbird	W	A/C/G
Quiscalus quiscula	common grackle	YR	A/C/G, WS/S
Quiscalus major	boat-tailed grackle	YR	SM, M/ES
Sturnella magna	eastern meadowlark	YR	A/C/G
Sturnus vulgaris	European starling	YR	A/C/G
Icterus spurious	orchard oriole	Br	A/C/G, UF, US/S
Icterus galbula	Baltimore oriole	W, Br	UF

Table B-9: Common Birds in Region 9 and their Associated Habitats - Passerine Birds (continued)

Scientific Name	Common Name	Season*	**Habitats (see Table B-11 for key)**
Piranga rubra	summer tanager	Br	UF
Passer domesticus	house sparrow	YR	A/C/G
Spiza americana	dickcissel	Br	A/C/G
Cardinalis cardinalis	northern cardinal	YR	A/C/G, UF, US/S
Carpodacus purpureus	purple finch	W	UF
Carduelis tristis	American goldfinch	W, Br	US/S, A/C/G, UF
Guiraca caerulea	blue grosbeak	Br	US/S, WS/S, A/C/G
Passerina cyanea	indigo bunting	Br	A/C/G, US/S
Passerina ciris	painted bunting	Br	US/S, UF, A/C/G
Pipilo erythrophthalmus	rufous-sided towhee	YR, W	UF, US/S
Zonotrichia spp.	sparrows	W	UF, WF, US/S, WS/S, A/C/G, FM, B/IM, SM

*Br = present during breeding season (generally spring and/or summer)
W = present in winter
YR = present year round

Table B-10: Common Fish and Shellfish in Region 9 and their Associated Habitats

Scientific Name	Common Name	**Habitat (see Table B-11 for key)***
Hybognathus nuchalis	Mississippi silvery minnow	FW
Hybognathus hayi	cypress minnow	FW
Notropis spp.	shiners	FW
Notemigonus crysoleucas	golden shiner	FW
Phenacobius mirabilis	suckermouth minnow	FW
Pimephales vigilax	bullhead minnow	FW
Carpiodes carpio	river carpsucker	FW
Semotilus atromaculatus	creek chub	FW
Cyprinus carpio	common carp	FW
Aphredoderus sayanus	pirate perch	FW
Gambusia affinis	mosquito fish	FW
Morone chrysops	white bass	FW
Morone mississippiensis	yellow bass	FW
Morone saxatilis	striped bass	FW, BW, SW
Micropterus punctulatus	spotted bass	FW
Micropterus salmoides	largemouth bass	FW
Ambloplites rupestris	rock bass	FW
Lepomis cyanellus	green sunfish	FW
Lepomis macrochirus	bluegill	FW
Lepomis gulosus	warmouth	FW
Lepomis megalotis	longear sunfish	FW
Lepomis microlophus	redear sunfish	FW
Lepomis punctatus	spotted sunfish	FW
Lepomis humilis	orangespotted sunfish	FW
Lepomis symmetricus	bantam sunfish	FW
Lepomis spp.	hybrid sunfish	FW
Centrarchus macropterus	flier	FW
Pomoxis annularis	white crappie	FW
Pomoxis nigromaculatus	black crappie	FW
Ammocrypta clara	sand darter	FW
Etheostoma zonale	banded darter	FW
Aplodinotus grunniens	freshwater drum	FW
Lepisosteus oculatus	spotted gar	FW
Lepisosteus osseus	longnose gar	FW, BW
Lepisosteus platostomus	shortnose gar	FW
Lepisosteus spatula	alligator gar	FW, BW
Amia calva	bowfin (or choupique)	FW
Ictiobus cyprinellus	bigmouth buffalo	FW
Ictiobus babalus	smallmouth buffalo	FW
Ictiobus niger	black buffalo	FW
Ictalurus furcatus	blue catfish	FW, BW
Ictalurus punctatus	channel catfish	FW
Ictalurus natalis	yellow bullhead	FW
Noturus spp.	madtoms	FW
Pylodictis olivaris	flathead catfish	FW
Mugil cephalus	striped mullet	FW, BW, SW
Fundulus notatus	blackstripe topminnow	FW
Fundulus notti	bayou topminnow	FW
Polyodon spathula	paddlefish	FW
Scaphirhynchus platorynchus	shovelnose sturgeon	FW
Dorosoma cepedianum	gizzard shad	FW, BW
Dorosoma petenense	threadfin shad	FW, BW
Anguilla rostrata	American eel	FW, BW, SW
Cyprinodon variegates	sheephead minnow	FW, BW, SW
Poeciliidae	livebearers	FW
Acipenser oxyrinchus desotoi	Gulf sturgeon	FW, BW, SW
Macrobrachium ohione	river shrimp	FW
Palaemonetes spp.	grass shrimp	FW, BW, SW
Procambarus clarkii	red swamp crawfish	FW
Procambarus acutus	white river crawfish	FW

*FW = Fresh Water, BW = Brackish Water, SW = SaltWater

Table B-11 Key for Habitat Type Abbreviations in Tables B-1 through B-10.

Habitat Type	Abbreviation
Saltwater Marsh	SM
Brackish/Intermediate Marsh	B/IM
Freshwater Marsh	FM
Wetland Forest	WF
Wetland Scrub-Shrub	WS/S
Mangrove Swamp	MS
Upland Forest	UF
Marine/Estuarine Submerged Aquatic Vegetation (SAV)	M/ESAV
Freshwater SAV	FSAV
Batture	B
Agriculture-Cropland-Grassland	A/C/G
Freshwater Shore	FS
Marine/Estuarine Shore	M/ES
Upland Scrub/Shrub	US/S
Wetland Barren	WB
Upland Barren	UB
Water	W
Marine/Estuarine Benthic	M/EB
Freshwater Benthic	FB
Marine/Estuarine Encrusting Communities	M/EEC
Living Reefs	LR