DRAFT DAMAGE ASSESSMENT AND RESTORATION PLAN / ENVIRONMENTAL ASSESSMENT

for the

Tank Barge DBL 152 Oil Spill
(Federal waters of the Gulf of Mexico, beginning November 11, 2005)

March 2013

Prepared by the
National Oceanic & Atmospheric Administration

Executive Summary

Beginning on November 11, 2005, the Tank Barge (T/B) DBL 152, owned and operated by K-Sea Transportation Partners LP (the Responsible Party, hereinafter the "RP"), discharged an estimated 1.925 million gallons of a blended mixture of heavy oil into federal waters in the Gulf of Mexico (the "Incident"). The bulk of the released oil sank to the sea floor. Approximately 98,910 gallons were recovered during submerged oil cleanup activities, which continued until January 12, 2006. At that time recovery operations were suspended by the Unified Command operating under the U. S. Coast Guard's Incident Command System. Long-term monitoring (LTM) occurred from January 13, 2006 to February 8, 2007, during which time the movement and dissipation of non-recovered submerged oil was tracked to the extent possible. A natural resource damage assessment (NRDA) was performed to determine the nature and extent of injuries to natural resources and services and identify restoration alternatives to compensate the public for those injuries. The National Oceanic and Atmospheric Administration (NOAA), a federal agency within the U. S. Department of Commerce, is the sole natural resource trustee for this Incident. NOAA's trust resources include, but are not limited to, commercial and recreational fish species, anadramous and catadromous fish species, marshes and other coastal habitats, marine mammals, and endangered and threatened marine species.

Draft Plan to Restore Natural Resources

The natural resources and services affected by the Incident and the restoration alternative preferred by NOAA are described in this Draft Damage Assessment and Restoration Plan/Environmental Assessment (Draft DARP/EA). This Draft DARP/EA was developed by NOAA.

What was injured?

Injury to benthic invertebrates, demersal fishes, pelagic fishes, and marine mammals resulted from the released oil from smothering and coating of benthic resources and ingestion by animals that feed on benthic resources and demersal fishes in the affected area. Contact with oil or ingestion of oil or oiled prey may have acute or chronic effects on these organisms, including physical effects (such as smothering) and toxicological effects. Additionally, the presence of discharged oil in the environment may have caused decreased habitat utilization of the area, altered migration patterns, altered food availability, and disrupted life cycles.

Monitoring efforts documented the presence of oil in the water column near the spill site and in offshore benthic habitats. The cumulative, but discontinuous, oiling footprint covered approximately 45,000 acres (70.3 square miles) to the west-northwest of the discharge point. Submerged oil moved over time and, therefore, did not occupy this entire area at the same time. Injuries to the seafloor and associated resources were not uniform or continuous.

How was the preferred restoration alternative identified?

NOAA considered various alternatives to compensate the public for lost resources and services. Each alternative was evaluated using six criteria before a preferred restoration alternative was identified. The criteria were:

- Cost to carry out the alternative;
- Extent to which each alternative is expected to meet NOAA's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;
- Likelihood of success of each alternative;
- 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;
- Extent to which each alternative benefits more than one natural resource and/or service; and
- Effect of each alternative on public health and safety.

What is the preferred restoration alternative?

NOAA considered seven restoration alternatives exhibiting a sufficient nexus to the natural resources injured by the discharge and that could potentially compensate for injuries to natural resources and services. In-kind habitat restoration projects benefiting offshore water column and benthic mud habitats were deemed not to be desirable because of prohibitive restoration costs and significant logistical challenges in execution. An estuarine shoreline protection and marsh creation project, therefore, is NOAA's preferred restoration alternative to compensate the public for impacts to natural resources and services resulting from the Incident. Shoreline protection and marsh creation undertaken using the proposed techniques have successfully provided improved ecological services in a cost effective manner in the past. Shoreline protection and marsh creation projects of the type proposed also have a high likelihood of success.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS, ABBREVIATIONS & SYMBOLS

ANWR	Anahuac National Wildlife Refuge
API	American Petroleum Institute
AR	Administrative Record
Bbls	Barrels (1 barrel equals 42 U.S. Gallons)
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DARP/EA	Damage Assessment and Restoration Plan / Environmental Assessment
DSAY	Discounted Service Acre Year
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EqDSAY	Equivalent Discounted Service Acre Year
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FWCA	Fish and Wildlife Coordination Act
GIWW	Gulf Intra-coastal Waterway
GMFMC	Gulf of Mexico Fishery Management Council
GPS	Global Positioning System
ITB	Integrated Tug-Barge
HEA	Habitat Equivalency Analysis
JCND	Jefferson County Navigation District
LNG	Liquefied Natural Gas
LTM	Long-Term Monitoring
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NDBC	National Data Buoy Center
NEPA	National Environmental Policy Act
nm	Nautical Mile (1 nm equals 6,076 feet)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent (to Conduct Restoration Planning)
NPDES	National Pollution Discharge Elimination System
NPFC	National Pollution Funds Center
NRDA	Natural Resource Damage Assessment
NWR	National Wildlife Refuge
OPA	Oil Pollution Act of 1990
PADR	Preassessment Data Report
PAH	Polycyclic Aromatic Hydrocarbon
PHA	Port of Houston Authority
ppt	Parts per thousand
ROV	Remotely Operated Vehicle
RP	Responsible Party
SAV	Submerged Aquatic Vegetation

TABS	Texas Automated Buoy System
T/B	Tank Barge
TCPNWRC	Texas Chenier Plain National Wildlife Refuge Complex
TGLO	Texas General Land Office
TPWD	Texas Parks and Wildlife Department
USACE	United States Army Corps of Engineers
USC	United States Code
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
V-SORS	Vessel-Submerged Oil Recovery System

CHAPTER 1: INTRODUCTION

This Draft Damage Assessment and Restoration Plan/Environmental Assessment (Draft DARP/EA) was prepared by the National Oceanic and Atmospheric Administration (NOAA), to inform the public about injury assessment and restoration planning conducted after oil was discharged from the Tank Barge (T/B) DBL 152. Oil was discharged into federal waters of the Gulf of Mexico between approximately 35 and 50 miles southeast of Sabine Pass on the Texas-Louisiana border. The T/B DBL 152 was owned and operated by K-Sea Transportation Partners, LP. Under the federal Oil Pollution Act of 1990 (OPA), K-Sea Transportation Partners, LP is the Responsible Party (the "RP") liable for natural resource damage assessment (NRDA) costs and natural resource damages (*i.e.,* the costs of restoration to compensate for injuries to resources).

The RP engaged in a cooperative assessment process with NOAA since the time of the spill, a process which was formalized in writing in May 2007. In May 2009, during the course of discussions regarding a claim for restoration costs, the RP was determined to have reached its limit of liability under OPA. The OPA liability limits restrict, in most circumstances, the amount for which an RP may be held liable for, among other things, natural resource damages. The OPA provides that any costs or damages above and beyond these liability limits may be paid by the United States Coast Guard's National Pollution Funds Center (NPFC). Therefore, if an RP that has reached its liability limit pays a claim for natural resource damages made by a Trustee, the RP may, in turn, seek reimbursement of these costs from the NPFC. Alternatively, if an RP in those circumstances declines to pay such a claim, NOAA may then present the claim directly to the NPFC. In this case, the NPFC determined in early 2009 that the liability limits of the OPA do apply to the RP and that the RP already exceeded those limits with costs related to the oil spill response. Accordingly, NOAA anticipates presenting its claim for injury assessment, restoration planning, and restoration implementation directly to the NPFC for payment. Ultimately, any funds recovered by NOAA will be used to conduct on-the-ground natural resource "restoration" projects.

The purpose of restoration projects conducted with NRDA funds is to make the environment and the public whole for injuries resulting from the Incident. Under the OPA, restoration alternatives must either return injured trust resources and services to "baseline" (the condition natural resources would have been in had the Incident not occurred) or compensate the public for interim losses (the loss of natural resource services from the time of the injury until full recovery). This requirement is achieved through restoration, rehabilitation, replacement, or acquisition of equivalent natural resources and/or services (33 U.S.C. §2706(b)). Thus, this Draft DARP/EA only considered project alternatives with a connection between the natural resources and services injured and the resources and services to be restored.

NOAA seeks the public's input on the preferred restoration alternative presented in this Draft DARP/EA. Any comments received during the public comment period will be considered prior to selecting a restoration alternative for implementation and identifying it in a Final DARP/EA. NOAA will then present the selected restoration alternative to the NPFC for the costs of conducting the natural resource damage assessment and the costs of implementing the selected restoration alternative.

1.1 INCIDENT SUMMARY

On November 11, 2005, while en route from Houston, Texas, to Tampa, Florida, the integrated tug-barge unit comprised of the tugboat “Rebel” and the double-hull Tank Barge (T/B) DBL 152, owned and operated by the RP, struck the submerged remains of a pipeline service platform, located in West Cameron Block 229, which collapsed during Hurricane Rita. The barge was carrying approximately 119,793 barrels (bbls) (5,031,306 gallons) of a blended mixture of low-API gravity (4.5º) oil (i.e., a heavy oil, likely to sink). The starboard bow cargo and ballast tanks were punctured, at which time the barge began taking on water and releasing oil. Initially, a portion of the oil floated forming an oil slick on the surface. It was later determined that the bulk of the released oil sank to the bottom.

Following the Incident, the tug and barge were separated for safety reasons, but remained in close proximity. The barge was eventually towed by the tug towards shore with the intent of grounding and stabilizing it in shallower water to facilitate salvage and lightering and to minimize the risk of striking oil pipelines buried within the seabed. The barge grounded farther from shore than anticipated in about 50 feet of water, approximately 35 nautical miles (nm) south-southeast of Sabine Pass, Texas, or approximately 13 nm west-northwest of where the Incident occurred (Figure 1). Once grounded, the barge continued listing severely and slowly releasing oil from unsealed vents and hatches. On November 14, 2005, the barge capsized, and additional oil was released in a relatively short period of time and was deposited on the seafloor as discrete mats or pools of submerged oil.

Extensive operations to locate, assess and recover the submerged oil were initiated shortly after the barge capsized. Full-scale submerged oil recovery efforts using diver-directed pumping were initiated by early December 2005. Submerged oil cleanup activities were continued subject to intermittent weather delays until January 12, 2006, at which time recovery operations were suspended by the Unified Command. Long-term monitoring of non-recovered submerged oil was initiated in January 2006 and continued until mid-January 2007. Based on the results of long-term monitoring (which tracked the movement and dissipation of the oil over time, as described in Section 3.2.1) and ongoing feasibility constraints, no additional submerged oil recovery was performed after January 2006.

An estimated 45,846 bbls of oil (1,925,532 gallons) were discharged into federal waters of the Gulf of Mexico as a result of this Incident. Of this volume, an estimated 2,355 bbls (98,910 gallons) were recovered by divers. In total, an estimated 43,491 bbls (1,826,622 gallons) of oil remained unrecovered at the time submerged oil cleanup operations were discontinued in January 2006. The fate and transport of unrecovered oil after January 2006 is discussed in Section 3.2.1.

Figure 1. Location of T/B DBL 152 Incident. Graphic Credit: ENTRIX, Inc.

1.2 <u>DETERMINATION OF JURISDICTION TO CONDUCT NATURAL RESOURCE DAMAGE ASSESSMENT</u>

Pursuant to section 990.41 of the regulations for conducting a NRDA under the OPA, 15 CFR Part 990, NOAA determined that jurisdiction to pursue restoration under the OPA exists for this Incident. The oil spill constitutes an "incident" within the meaning of section 1001(14) of OPA. Because the discharge was not authorized by a permit issued under Federal, State, or local law, and did not originate from a public vessel or from an onshore facility subject to the Trans-Alaska Pipeline Authorization Act, the Incident is not an "excluded discharge" within the meaning of the OPA, section 1002(c). Finally, natural resources under NOAA's trusteeship have been injured as a result of the Incident (natural resource injuries are discussed more fully below). These factors established jurisdiction to proceed with an assessment under the OPA NRDA regulations and were discussed in more detail in a Notice of Intent (NOI) to Conduct Restoration Planning, which was published in the Federal Register on April 8, 2009.

1.3 DETERMINATION TO CONDUCT RESTORATION PLANNING

In accordance with 15 CFR 990.42, and as detailed in the NOI, NOAA for this Incident determined that the requisite conditions existed to justify proceeding with natural resource damage assessment and restoration planning beyond the preassessment phase. These conditions, discussed more fully below, include: existence of natural resource injuries resulting from the discharge or from associated response actions; insufficiency of response actions to fully restore natural resource injuries and losses; and the existence of feasible actions to address the injured resources.

1.4 PUBLIC COORDINATION

NOAA has provided, and continues to provide, information to the public regarding the injury assessment and restoration planning process. As mentioned above, on April 8, 2009, NOAA published the NOI in the Federal Register (Vol. 74, No. 66, pgs. 15941-15943). In addition, concurrent with the publication of the NOI, NOAA opened an Administrative Record (AR) to facilitate public involvement in the restoration planning process (the AR Index can be found in Appendix A). The public can obtain relevant injury assessment reports in the AR, and contact agency personnel to obtain more information.

Public review of this Draft DARP/EA is an integral component of the restoration planning phase. Through the public review process, NOAA seeks comment on the alternatives proposed to restore injured natural resources and replace lost services. This Draft DARP/EA is being made available to the public for comment through April 15, 2013. Public review of the Draft DARP/EA will be consistent with all applicable laws and regulations that apply to the NRDA process, including section 1006 of the OPA, the NRDA regulations at 15 CFR Part 990, the National Environmental Policy Act (NEPA, 42 U.S.C. 4371 *et seq.*), and the regulations implementing the NEPA (40 CFR 1500 *et seq.*). Any comments received during the public comment period will be considered prior to publishing the Final DARP/EA.

Written comments on the Draft DARP/EA should be submitted to: Chris Plaisted, NOAA/GCNR, 501 W. Ocean Blvd., Suite 4470, Long Beach, CA 90802, FAX: 562–980–4065. Alternatively, comments may be submitted electronically at www.regulations.gov (Docket I.D.: NOAA-NMFS-2013-0034). All comments received, including names and addresses will become a part of the administrative record. The Draft DARP/EA is available at: http://www.darrp.noaa.gov/southeast/dbl152/admin.html.

1.5 ADMINISTRATIVE RECORD

The AR for this Incident contains documents relevant to the NRDA process. The AR facilitates public participation in the restoration planning process and will be available for use in future administrative or judicial review of Trustee actions to the extent provided by law.

A copy of the AR index as of the date of publication of this Draft DARP/EA is provided in Appendix A. Additional restoration planning documents and public comments received on the Draft DARP/EA will be included in the final AR. Documents included in the AR are available at the NOAA website:

http://www.darrp.noaa.gov/southeast/dbl152/admin.html

In addition, hard copies of documents are available by contacting:

NOAA Restoration Center
Attention: Kristopher Benson
4700 Avenue U
Galveston, TX 77551
Phone: (409) 621-1200
Fax: (409) 766-3575

CHAPTER 2: PURPOSE AND NEED FOR RESTORATION

The purpose of the proposed action identified in this Draft DARP/EA is to restore natural resources, and the ecosystem services provided by those resources, that were injured or lost as a result of the Incident. NOAA has been designated a natural resource trustee under the OPA (33 U.S.C. 2706(b)) and the National Contingency Plan (40 CFR 300.600 *et seq*.), for natural resources and services injured by this Incident. As a designated trustee, NOAA is authorized to act on behalf of the public to assess natural resource damages and to plan and implement actions to restore natural resources and services injured or lost as the result of a discharge or substantial threat of a discharge of oil. The objective of the preferred restoration alternative identified in this Draft DARP/EA is to compensate the public for injuries to natural resources and natural resource services resulting from the Incident.

2.1 OPA AND NRDA OVERVIEW

The NRDA process is described fully in the OPA NRDA regulations at 15 CFR Part 990 and consists of three phases: (1) Preassessment, (2) Restoration Planning, and (3) Restoration Implementation. During the preassessment phase of the Incident, NOAA determined whether it had jurisdiction to pursue a NRDA for the Incident. In this Incident, since the injuries were not fully addressed or restored by response activities, and because feasible restoration alternatives exist to address those injuries, NOAA proceeded with the Restoration Planning Phase. Restoration planning was necessary because injuries were expected to continue, resulting in interim losses of natural resources and services from the date of the Incident until the date of eventual recovery. In the Restoration Planning phase, NOAA identified a reasonable range of restoration alternatives, evaluated and identified a preferred alternative, and developed this Draft DARP/EA presenting the preferred alternative(s) to the public. NOAA is soliciting public comment on this Draft DARP/EA and will consider these comments before finalizing the Draft DARP/EA.

Upon completion of the Final DARP/EA, NOAA anticipates submitting a claim to the NPFC for the costs of conducting a natural resource damage assessment and of implementing the preferred restoration alternative, should it be selected after public comments on this DARP/EA are received and considered.

CHAPTER 3: INJURY ASSESSMENT AND DETERMINATION

As the Incident occurred in Federal waters and no wildlife impacts were observed, NOAA was the only natural resource Trustee participating in the NRDA for this Incident. The other Federal, Texas, and Louisiana state trustees were periodically informed of Incident progress.

The RP and NOAA representatives worked cooperatively during the response and preassessment phases of this Incident. As required by the OPA NRDA regulations, NOAA invited the RP to participate in a cooperative damage assessment at the time of the spill. This was formalized in a letter dated December 7, 2006. The RP accepted NOAA's offer in a letter dated January 22, 2007. Subsequently, NOAA and the RP developed a set of mutually agreeable Guiding Principles for conducting the cooperative NRDA in lieu of a detailed Memorandum of Agreement/Understanding. These Guiding Principles were set forth in a letter from the RP to NOAA dated May 10, 2007.

Using this cooperative assessment approach, NOAA quantified the nature, degree, and extent of injuries to natural resources and services resulting from the DBL 152 Incident. Injuries were assessed following the discharge of oil and the subsequent response and recovery actions. Injury assessment continued during the preassessment and restoration planning phases of the NRDA process. NOAA ultimately used a Habitat Equivalency Analysis (HEA) model to quantify injuries to natural resource injuries and services.

3.1 OVERVIEW OF THE PREASSESSMENT PHASE AND FINDINGS

NOAA initiated preassessment activities for the DBL 152 Incident shortly after notification of the discharge. NOAA focused on collecting ephemeral data that would address three criteria defined by the OPA NRDA regulations (15 CFR 990.42):

- injuries have resulted, or probably will result, from the Incident;
- response actions have not adequately addressed, or are not expected to address, the injuries resulting from the Incident; and
- feasible primary and/or compensatory restoration actions exist to address the potential injuries.

All of these criteria should be addressed before the restoration planning phase begins. The response and preassessment phases of this Incident can be subdivided into two periods. The initial response period includes the interval from November 11, 2005, to January 12, 2006, during which time recovery of submerged oil was actively pursued, supported by various efforts to detect and assess submerged oil. Salvage and lightering operations to remove the remaining oil and secure the vessel in preparation for towing to a shore facility were also performed during this period. The long-term monitoring period includes the interval from January 13, 2006, until February 28, 2007. During this time, efforts were implemented to track the movement and dissipation of non-recovered submerged oil; however, no additional submerged oil recovery was performed.

Using the information collected during the preassessment phase, NOAA determined that injuries had occurred as a result of the Incident, and while response actions were taken quickly, they were unable to fully address the impacts of the release of oil to the environment. Additionally, feasible compensatory restoration projects exist to address the injuries. Since all three OPA criteria listed above were met, NOAA released a Notice of Intent to Conduct Restoration Planning and proceeded into the restoration planning phase.

3.2 INJURY ASSESSMENT STRATEGY

The goal of injury assessment under the OPA is to determine the nature, degree, and extent of injuries to natural resources and services, thus providing a technical basis for evaluating the need for, type of, and scale of restoration actions. The OPA NRDA regulations define injury as "an observable or measurable adverse change in a natural resource or impairment of a natural resource service. Injury may occur directly or indirectly to a natural resource and/or service" (15 CFR §990.30). There are two stages to injury assessment: injury determination and injury quantification. Generally, the former is a process to determine whether an injury occurred, and the latter is a process to determine the extent and severity of the injury. Injury determination began with the identification and selection of potential injuries to investigate. Under the OPA regulations, NOAA considered several factors when making the injury determination, including, but not limited to:

- the natural resources and services of concern;
- the evidence indicating exposure, pathway and injury;
- the mechanism by which injury occurred;
- the type, degree, spatial and temporal extent of injury;
- the adverse change or impairment that constitutes injury;
- available assessment procedures and their time and cost requirements;
- the potential natural recovery period; and
- the kinds of restoration actions that are feasible.

NOAA considered all of the factors listed above before injury determinations (discussed below) for this Incident were made.

3.2.1 INJURY ASSESSMENT PROCEDURES

NOAA considered five factors identified in the OPA regulations before selecting injury assessment procedures:

- the range of procedures available under the OPA regulations (15 CFR 990.27(b));
- the time and cost necessary to implement the procedures;
- the potential nature, degree, and spatial and temporal extent of the injury;
- the potential restoration actions for the injury; and
- the relevance and adequacy of information generated by the procedures to meet information requirements of restoration planning.

Conducting assessment activities was particularly challenging in this case, since the spill occurred far offshore in an area where oil sank to depths of about 60 feet. The types of environmental sampling, observations, and data collection that Trustees normally conduct as part of an assessment were significantly restricted by logistical, cost, and safety concerns.

Accordingly, NOAA and the RP agreed to use simple, valid, and cost-effective procedures to document natural resource and service injuries. These procedures relied on information gathered from the response and preassessment phase activities, relevant peer-reviewed literature, and the best professional judgment of local experts and Trustees familiar with the effects of oil releases in similar environments. NOAA's assessment of natural resource injuries focused on offshore benthic and water column habitats because water column organisms were potentially exposed to oil as it sank and oil remained on or near the seafloor in measurable quantities for an extended period of time.

Submerged Oil Assessment during Initial Response

Throughout the initial response, information about the location, concentration and movement of submerged oil was critically important for supporting oil recovery operations and predicting the fate and transport of oil. Unlike spills of floating oil, where oil can be readily observed using familiar techniques (e.g., overflights, shoreline surveys), submerged oil detection and assessment is considerably more challenging.

The Environmental Unit, operating under the U.S. Coast Guard's Incident Command System, employed a variety of equipment and techniques to locate, characterize and track submerged oil: divers; chain-weighted snare drags using devices called V-SORS (Vessel-Submerged Oil Recovery System); vertical snare sentinels; acoustic remote sensing; and remotely operated vehicles (ROV). Meteorological and oceanographic data reported by various sources were also compiled during the response to better understand the factors affecting the transport and fate of discharged oil. These efforts are summarized in the sections below.

Divers

Initial reconnaissance of submerged oil was provided by divers surveying the Incident site, the various debris fields and the area immediately surrounding the disabled barge. Divers were used in support of salvage, lightering and submerged oil recovery operations, as well as in efforts to obtain source oil samples and calibrate/verify results obtained from other oil identification methods. Conditions dictated the use of surface-supplied divers tethered by air lines to an anchored vessel. Divers were equipped with voice communications to relay information to the surface. Some dive teams also utilized video cameras, which allowed diver observations to be viewed by support personnel topside and recorded. Unrecorded dive observations were communicated via brief written dive reports or verbal debriefings. Dive surveys were constrained by limited bottom-time (due to decompression requirements), restricted mobility, and at certain times, poor visibility.

Vessel-Submerged Oil Recovery Systems (V-SORS)

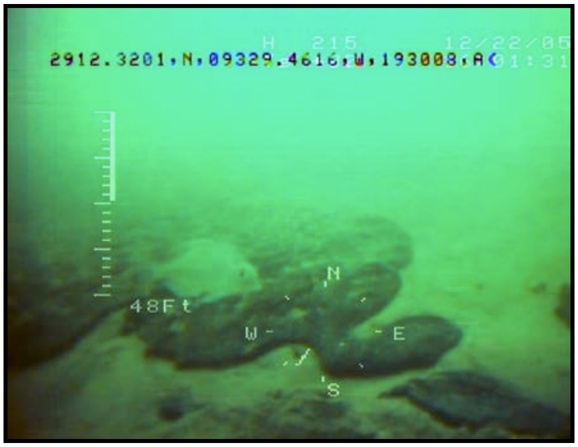
The primary data collection method for submerged oil was chain-weighted snare drags using devices know as V-SORS. Though initially conceived as a submerged oil recovery device during another spill, the V-SORS proved most useful as a means of detecting submerged oil during this Incident.

Two versions of the V-SORS device were used for this Incident. The original configuration, later called “V-SORS Heavy,” consisted of an 8-foot wide header beam constructed of heavy steel pipe trailing twenty-five 8-foot long heavy-link chains to which six to eight viscous snare pompoms were attached along the length of every other chain (see Figure 2). Deployment and retrieval of V-SORS Heavy devices required a crane or other overhead lifting equipment.

Due to operational constraints, a scaled-down version, known as “V-SORS Light,” was developed. The V-SORS Light device consisted of two 8-foot lengths of heavy-link chain each carrying three snare pompoms attached to the end of a single rope. V-SORS Light were deployed and retrieved by hand often with two units simultaneously towed from opposite sides of a vessel.

Both V-SORS Heavy and V-SORS Light were towed across the seafloor along designated transects using GPS for navigation. At specified intervals, the V-SORS device was hoisted to the surface to inspect the pompoms. The amount of oil on the pompoms was visually assessed and a qualitative level of oiling (heavy, medium, light & very light) was assigned to the transect. A pictorial job aid was created to help ensure consistent classification of oiling levels on snares across multiple teams (See Figure 3). In addition, the composition of V-SORS survey teams remained as consistent as possible, also to promote uniformity in the results.

V-SORS provided a spatially integrated assessment of submerged oil along transects at a specific point in time. Survey resolution was dependent upon distance between transects and retrieval frequency.



ROV video image of submerged oil from T/B DBL 152, 22 December 2005

Disabled vessel before capsizing showing discharge of oil, November 2005

V-SORS Heavy chain drag used to detect submerged oil, December 2005

Crab pot sentinels used to detect submerged oil, December 2005

Oiled snares associated with a camera drop, September 2006

Figure 2. Representative response and preassessment phase photographs.

Photo credits: ENTRIX, Inc.

Figure 3. Representative examples of qualitative oiling levels on V-SORS Light.
Photo credits: ENTRIX, Inc.

Vertical Snare Samplers/Snare Sentinels

These devices initially consisted of a snare on a rope with an anchor on one end and a buoy float on the other. Later iterations also included snare-filled crab pots positioned to rest on the bottom. These devices were deployed at specific locations for one or more days to detect submerged oil on the seafloor and suspended in the water column. Unlike V-SORS, stationary vertical snare samplers and snare sentinels provided a time-integrated assessment at a single location.

Acoustic Remote Sensing

Two types of acoustic remote sensing were used during the T/B DBL 152 response: a proprietary seabed classification system and side scan sonar. The seabed classification system was briefly tested for its ability to detect submerged oil, but initial results were mixed due to equipment difficulties and heavy seas. Its use was discontinued after only a short period based on the inconclusive nature of the results and the narrow assessment swath along the bottom, which was a function of the relatively shallow water depth (50-60 feet).

Side scan sonar was initially used to survey debris around the Incident site and secondary debris field, but was later used experimentally for submerged oil detection. Initial trials to detect submerged oil with side scan sonar were promising. However, during a late-November 2005 survey of the area west (down-current) of the barge, only approximately 50 percent of suspected targets were found to actually contain submerged oil. The use of side scan sonar for submerged oil detection was eventually abandoned in this response due to the relatively high rate of false-positives under these conditions, the need to verify results visually and the significant lag time for data processing and interpretation.

Remotely Operated Vehicle

Beginning in early December 2005, submerged oil identification was performed using a tethered ROV. The ROV contained a video camera allowing continuous imagery of the seafloor to be viewed in real-time and recorded. However, the ROV lacked precise positioning, so its exact location over the seafloor could only be estimated relative to the support vessel. The ROV was the primary means of verifying suspected submerged oil patches identified using alternative methods (e.g., side scan sonar). It was also used to systematically survey the bottom in a grid pattern in other areas. Approximately 85 ROV surveys were conducted, mostly west and west-northwest of the barge. ROV use was constrained by limited mobility, and at times, rough seas, poor visibility and oil fouling.

Meteorological and Oceanographic Data Collection

Meteorological and oceanographic data reported by various sources were compiled during the response. Data sources included an ocean buoy deployed near the capsize location, as well as other buoys and National Data Buoy Center (NDBC) assets in the western Gulf of Mexico. Of key importance were the near-bottom and mid-water column current direction and velocity data provided by the Acoustic Doppler Current Profiler aboard the Texas Automated Buoy System (TABS) A2 buoy. Information on sea state (wave height, and dominant and average wave period) was obtained from NDBC Station 42035 located 22 nm east of Galveston, Texas, and Station 42019 located 60 nm south of Freeport, Texas. These ancillary data were used to better understand and potentially predict the movement of submerged oil in response to various environmental factors.

Submerged Oil Assessment during Long-Term Monitoring

Long-term monitoring (LTM) was initiated once active cleanup operations were suspended in January 2006. The LTM program was designed to:

- track the movement and fate of non-recovered submerged oil to assess its extent and continued dissipation;
- provide advance warning of potential impacts to Gulf Coast shorelines and other sensitive areas such as the Flower Garden Banks National Marine Sanctuary; and
- document changes in the oil’s chemical composition and physical properties through time due to weathering.

The LTM approach was initially designed to track the leading edge/perimeter of the submerged oil field, the term given to the area of seafloor containing scattered deposits of submerged oil at all oiling levels. Later LTM efforts characterized selected interior portions of the submerged oil field.

Long-Term Monitoring Using Stationary Samplers

LTM was initially performed using stationary samplers similar to the snare sentinels. Each LTM sampler consisted of two crab pots attached one on top of the other, with the bottom pot weighted to maintain an upright position. Each pot was loosely filled with white snare. A snare-filled cylinder approximately three feet high by ten inches in diameter constructed of wire mesh was suspended from the float to monitor for the presence of oil in the mid-water column. The mid-column sampler was positioned at half the water depth. The bottom end was weighted slightly to ensure the device remained vertical.

A total of 34 stationary LTM samplers were deployed beginning in January 2006. They were arranged in four arrays located north, south, east, and west of the capsize location. The stationary LTM samplers were checked approximately every two to four weeks during the LTM cruises. Oiled snare was replaced and samplers were redeployed or moved to new locations as appropriate. Representative samples of oiled snare were also collected.

Long-Term Monitoring Using V-SORS

In March 2006, the LTM plan was revised to address the ongoing loss of stationary samplers and data due to theft, weather, etc. The plan was modified to acquire data on the movement and extent of the submerged oil field using V-SORS Light instead of stationary samplers. The pattern of V-SORS chain drags and procedures for modifying the search area remained unchanged through June 2006. Monitoring was also performed at four locations containing higher concentrations of pooled or matted oil that was not cleaned up prior to suspension of recovery operations in January 2006. One or more of these areas was already planned as a set-aside for monitoring the dissipation of higher-concentration submerged oil accumulations. Samples of oiled snare continued to be collected from the V-SORS Light for chemical analyses.

Summary of Long-Term Monitoring Results Through July 2006

The results of seven LTM cruises conducted from January to June 2006 indicated the known submerged oil field was generally migrating to the west-northwest. The farthest occurrence of heavy oiling during the first six months of LTM, observed in late-March 2006, was approximately seven nm west-northwest of the capsize location. In mid-June 2006, moderate oiling approximately eight nm to the west-northwest was the heaviest oiling observed, with light and very light oiling observed up to approximately 13 nm to the west-northwest. LTM data indicated that portions of the submerged oil field were decreasing through time as the oil dissipated.

An eighth LTM survey was performed using V-SORS Light in mid-July 2006 to assess the entire submerged oil field, including its interior portions. The most prevalent oiling category along twelve transects in the surveyed area was very light oiling. Portions of the twelve transects also were described as not oiled, lightly oiled, moderately oiled, and heavily oiled. Patches of oil, qualitatively described as heavy and moderate using V-SORS Light, were identified approximately seven nm west-northwest of the capsize location within the submerged oil field in line with the general direction of observed oil movement.

Heavy Oil Patch Monitoring Through January 2007

Two additional surveys were performed in September 2006 to delineate a heavy oil patch identified during the mid-July 2006 LTM survey. These surveys also aimed to determine if the heavy oil was recoverable (defined by the Unified Command as concentrations of submerged oil sufficient for an estimated recovery rate of 500 bbls or more per diver recovery team per day), as well as to “calibrate” the results of the V-SORS Light apparatus by visually characterizing submerged oil using divers and an underwater drop camera.

The heavy oil patch surveys resulted in delineation of a patch of submerged oil qualitatively classified as “heavy oiling” concentrated within an area approximately 1,000 feet by 1,000 feet. The heavy oil patch was located approximately 1,475 feet to the west-northwest of the mid-July heavy oiling transect and was determined to be the same heavy oiling observed during the July survey. Divers estimated that the patch of submerged oil had an average oil thickness of approximately one inch, with a range of thickness between approximately one-half (½) to three inches.

The percent cover of oiled seafloor also was calculated within certain sections of the affected area. Percent cover estimates within sampled transects were quantitatively derived from underwater video imagery. Preliminary estimates of percent cover calculated from a subset of video data have been highly variable but may be used in assessing oil concentrations in particular areas or within transects of interest. The percent cover of oil within the patch determined from drop camera imagery along nine transects ranged from 19 percent to less than 1 percent with an average of 7.9 percent in late-September.

In late-October 2006, the Unified Command determined that threats to natural resources at risk did not warrant resuming submerged oil recovery. However, the parties agreed that continued monitoring of the heavy oil patch was prudent. The RP developed a new monitoring plan that tracked the movement and spatial characteristics of the heavy oil patch using V-SORS Light, divers and drop camera imagery, and continued chemical monitoring of weathered oil samples. The plan also included provisions for resuming submerged oil recovery if conditions warranted. The new monitoring plan was implemented in early-December 2006.

Three monitoring surveys were completed under this plan: two in December 2006 and one in mid-January 2007 (Figure 4). No heavy oiling was located during the December surveys. However, a small area of moderate oiling surrounded by light and very light oiling was delineated slightly west of the September 2006 location of the heavy oil patch. From these results, it was concluded that the small area of moderate oiling was the remains of the heavy oil patch, which had dissipated since the late-September observations. The mid-January 2007 survey revealed only light and very light oiling within the December survey locations, indicating continued dissipation of the oil. In addition, surveys in the area originally containing heavy and very heavy oiling in September 2006 revealed only light and very light oiling.

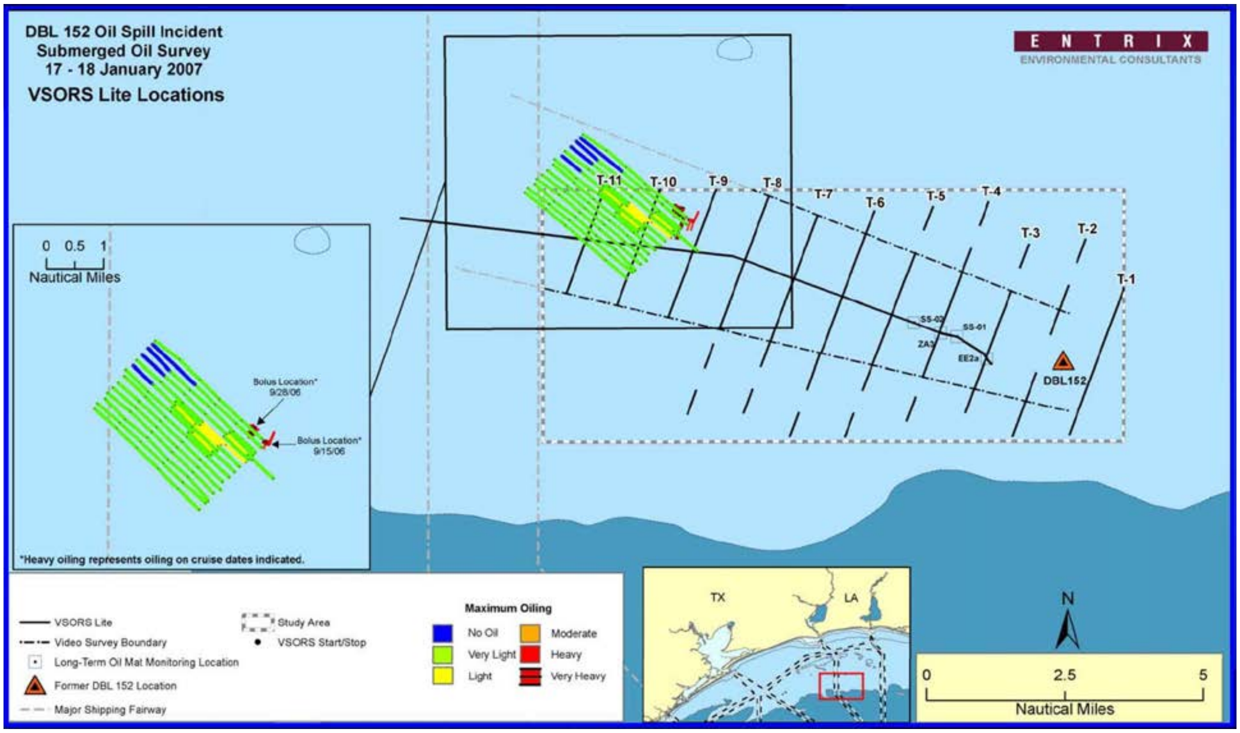


Figure 4. Submerged oil surveys undertaken Jan. 17-18, 2007. Graphic Credit: ENTRIX, Inc.

At the direction of the Unified Command, all LTM activities ceased after the mid-January 2007 monitoring cruise.

Source Oil Characterization

The oil loaded onto the T/B DBL 152 was a blend of five different oils mixed together to meet the desired product specification. The barge tanks were first filled with a mixture of all five oils that were "line blended" from each shore tank during loading. An additional quantity of one of the lighter API gravity oils was then loaded into the bottom of each tank as a last step to promote mixing, which occurs through upward mixing with the other oils by buoyancy forces and also by the rocking motion of the vessel during the voyage (pers. comm., J. Michel, Research Planning, Inc, 2005). The API gravity of the final mixture was 4.5.

Mass Balance

A mass balance/oil budget was prepared by the RP and submitted to the USCG to account for the volume of oil discharged during the Incident, the volume recovered and the volume remaining in the environment (ENTRIX, 2007). Information sources included various gauging reports, waste manifests, invoices, analytical reports and personal accounts.

Amount of Oil Discharged

The T/B DBL 152 was carrying 119,793 bbls (5,031,306 gallons) of oil at the time of the Incident. It is estimated that 45,846 bbls of oil (1,925,532 gallons) or approximately 38 percent of the barge's cargo was discharged into the Gulf of Mexico as a result of this Incident. This estimate is based on the initial volume of oil on board the barge and the amount of oil removed from the barge that never entered the environment.

Amount of Oil Recovered

It is estimated that at least 2,355 bbls (98,910 gallons) of submerged oil, or about five percent of the total volume released, were recovered from the seafloor by divers. An additional 74,947 bbls (3,147,774 gallons) of oil remaining on the barge after the Incident were removed during lightering and salvage operations. These figures do not reflect the volume of oil recovered as oily solid waste, tank bottoms (oily sludge), or adhered to V-SORS snares used for submerged oil detection, long-term monitoring, and cleanup at Theodore Industrial Port. The amount of recovered oil associated with each of these categories was considered negligible in comparison to the other oil volumes reported herein and was not quantified.

Amount of Unrecovered Oil

Based on the amounts of oil discharged and subsequently recovered, it is estimated that 43,491 bbls (1,826,622 gallons) of oil remained in the environment following termination of submerged oil recovery efforts. Loss of oil volume due to dissolution of soluble oil constituents into the water column was not quantified.

Oil & Environmental Samples

Following the spill, the Unified Command and natural resource trustees monitored submerged oil on the seafloor of the Gulf of Mexico for more than two years (Figure 5). Analytical and observational information collected during the response, long-term monitoring phase, and pre-assessment phase was used to support the injury assessment. The samples collected after the spill were summarized in the Preassessment Data Report (PADR, pages 14-17) and included the following: neat and weathered oil samples, benthic samples, trawl samples, sediment samples, and water column samples.

As of November 30, 2006, 184 total environmental and oil samples had been collected for oil fingerprinting, evaluating toxicity of the discharged oil to biota in the water column or sediments, and to support modeling of fate and transport of the unrecovered oil.

Neat Oil Samples

The RP collected samples of neat oil from each shore tank from which the barge was loaded and each tank on the barge prior to its departure from the loading facility (Houston Fuel Oil Terminal). These samples were collected and retained by Intertek Caleb Brett ("Intertek"), a consultant for the RP.

Following the Incident, Intertek provided RP and USCG representatives with split samples of the oil retained from each of the barge tanks. Intertek also provided these entities with a split sample of an oil mixture created in the laboratory by blending oil from each shore tank in the same relative proportions as loaded onto the barge. In addition, the RP collected additional oil from one of the barge's tanks immediately after the Incident. Physical and chemical analyses of neat oil samples were performed separately by NOAA (via Louisiana State University) and the RP.

Weathered Oil Samples

The RP also collected numerous weathered oil samples throughout the initial response and long-term monitoring periods. As used here, the term "weathered oil" refers to oil collected from the environment after being released from the barge. The actual degree of weathering depends on factors such as elapsed time since release and specific environmental conditions to which the oil was exposed. Weathered oil samples consisted of whole oil collected by divers and oiled pompoms from V-SORS or snare sentinels.

The RP collected 12 weathered oil samples during the response phase of the Incident. Most of these samples were taken during long-term monitoring events. These samples were analyzed for PAHs, alkanes, and biomarkers by TDI Brooks/B&B Laboratory.

Benthic Fauna Community Samples

Thirty-four surficial sediment samples consisting of the top two to four inches of sediment were collected by the RP during preassessment activities to evaluate the benthic invertebrate community in the affected area. These sediment samples were collected with Van Veen and ponar dredge-type samplers. Sample locations are shown in Figure 6.

This benthic invertebrate sampling was conducted opportunistically (i.e., without a statistically robust sampling design) by representatives of the RP, not as part of a joint NRDA study plan. NOAA was not present during the collection of the samples and did not participate in decisions about the methods used, analysis of the samples, or the potential applicability of the data to the NRDA. Due to the opportunistic nature of the sampling efforts, NOAA recognized that this data could not be reliably extrapolated out to the oiled zone in general and therefore was likely of little utility for the NRDA. Nevertheless, NOAA carefully considered the opportunistic benthic sampling results in relation to background literature and statistically robust sampling designs. Ultimately, NOAA declined to use the benthic analytical results during restoration scaling because it was concluded that the sampling methods lacked sufficient scientific rigor and because samples were not collected as part of a joint NRDA work plan.

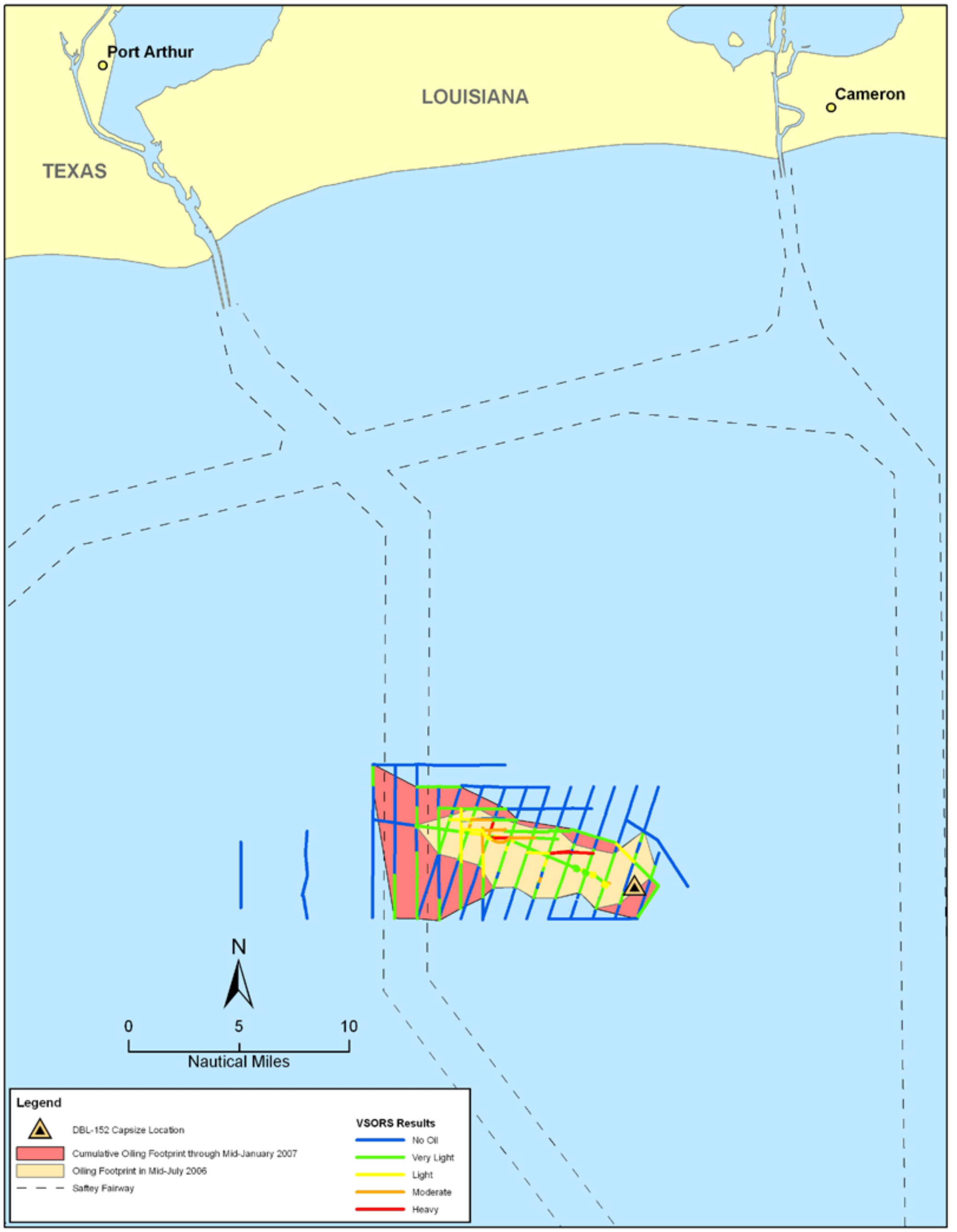


Figure 5. Cumulative extent of submerged oil based on V-SORS results during response and long-term monitoring. Graphic Credit: ENTRIX, Inc.

Trawl Samples

Trawl sampling was performed in December 2005 to qualitatively evaluate benthic macrofauna (crabs, etc.), demersal fish, and shrimp in the vicinity of the spill site. A total of four trawls were conducted using a 16-foot wide commercial otter trawl with 7/16th inch mesh size at the cod end. Two trawls were located west of the barge in areas potentially exposed to submerged oil. The other two trawls were located in unaffected areas east of the barge (Figure 6). Information and results of this effort are provided in Table 1.

Table 1. Results of preassessment trawl sampling performed December 22, 2005.

Trawl	Duration (minutes)	Speed (knots)	Length (nm)	Coordinates Deployment	Coordinates Retrieval	Catch
1 (R)	29	1.5 → 3.5	0.82	N 29.18992º W 93.45193º	N 29.19204º W 93.43652	3 perch (~3 inches long)
2 (R)	25	3.5	0.81	N 29.18954º W 93.43764º	N 29.18954º W 93.45084º	No catch
3	18	3.5	0.90	N 29.17426º W 93.53025º	N 29.15923º W 93.53094º	No catch
4	21	3.5	1.11	N 29.21210º W 93.55288º	N 29.21210º W 93.54764º	No catch

(R) denotes trawls in reference areas unaffected by the submerged oil located 1.5 & 1.7 nm southeast of the barge capsize site.

Like the benthic samples discussed above, the fish trawling activities were not conducted as part of a joint NRDA study plan. NOAA was not present during the collection of the samples and did not participate in decisions about the methods used, analysis of the samples by the laboratory, or the potential applicability of the data to the NRDA. Additionally, as discussed below in Section 3.3, NOAA determined that the likelihood of a fish injury was minimal and is, therefore, not asserting such a claim. Accordingly, it was unnecessary to use the trawl information in the injury assessment.

Sediment Chemistry Samples

Twelve surficial sediment samples were collected opportunistically by the response to make a screening-level determination as to whether submerged oil resulted in residual sediment contamination and, if so, whether such contamination posed a long-term toxicological risk to benthic biota and demersal fishes. An additional 31 sediment samples were taken by the RP during preassessment activities (Figure 6) and long-term monitoring events. These samples were collected with Van Veen and ponar dredge-type samplers.

Ultimately, these samples were not used during restoration scaling for the same reasons discussed above under "Benthic Fauna Community Samples" (i.e., the lack of a scientifically rigorous sampling design and the fact that the sampling was not an agreed-upon NRDA activity). NOAA ultimately determined that documenting the physical presence, degree, and spatial and temporal distribution of oil along the seafloor was the most robust and cost-effective method to estimate injuries to natural resources and services.

Water Column Samples

Thirty-seven water column samples were taken by the RP during the response phase of the Incident and 43 water column samples were collected by the RP during the preassessment activities (Figure 6). Samples were collected at the surface, mid-depth, and within one meter of the seafloor to identify the presence/absence of oil at different depths and distances from the vessel, thereby to better understand oil fate and transport after the spill. The RP chose to analyze the 80 samples to inform an assessment of risk to water column organisms, and NOAA supported that decision. NOAA used its Screening Quick Reference Tables (NOAA, 2004) to compare laboratory results for individual water samples to the acute ambient water quality screening value in marine waters for 17 individual parent PAHs as well as total PAH. Screening results are shown in Table 2 and summarized below.

Of the 80 water samples analyzed:

- Nine samples exceeded NOAA's acute ambient water quality screening value in marine waters for total PAH (300 parts per billion). Water samples that exceeded NOAA's total PAH screening value were collected from November 23, 2005 to January 11, 2006.
- Five samples exceeded NOAA's acute ambient water quality screening value in marine waters for both total PAH and phenanthrene (7.7 parts per billion). Water samples that exceeded NOAA's phenanthrene screening value were collected from December 26, 2005 to January 11, 2006.
- One sample exceeded NOAA's acute ambient water quality screening value in marine waters for total PAH, phenanthrene and 2-methylnaphthalene (300 parts per billion). This sample was collected on January 11, 2006.
- Seven of 39 samples collected within 1 meter of the sea floor directly above large patches of submerged oil exceeded one or more screening values. Concentrations of dissolved PAHs are expected to be highest in close proximity to submerged oil deposits. In addition, all but two of the bottom samples with exceedances were collected near locations where submerged oil recovery operations were taking place, which is expected to have increased localized mixing. At one location where submerged oil recovery was not being performed, fish were observed congregating around structure (e.g., debris from the collapsed platform) in close proximity to submerged oil patches; however, no obvious adverse impacts were recorded.
- Two of 28 samples collected from the mid-water column an estimated 15 to 25 feet above areas containing submerged oil exceeded one or more screening values. Both of these samples were collected by divers at locations where submerged oil recovery operations were taking place.
- None of the thirteen samples collected from just below the water surface exceeded any of the screening values.

As noted above, several water samples collected in the submerged oil field indicated that aquatic organisms at some locations may have been exposed to elevated levels of dissolved PAHs that exceeded ecological risk benchmarks. However, as discussed below in section 3.3, NOAA ultimately concluded that such exposure to mobile water column organisms was likely to be short term and of low magnitude and, therefore, decided not to assert a claim for injuries to animals in the water column. Accordingly, it was unnecessary to use the water column chemistry information in NOAA's injury quantification.

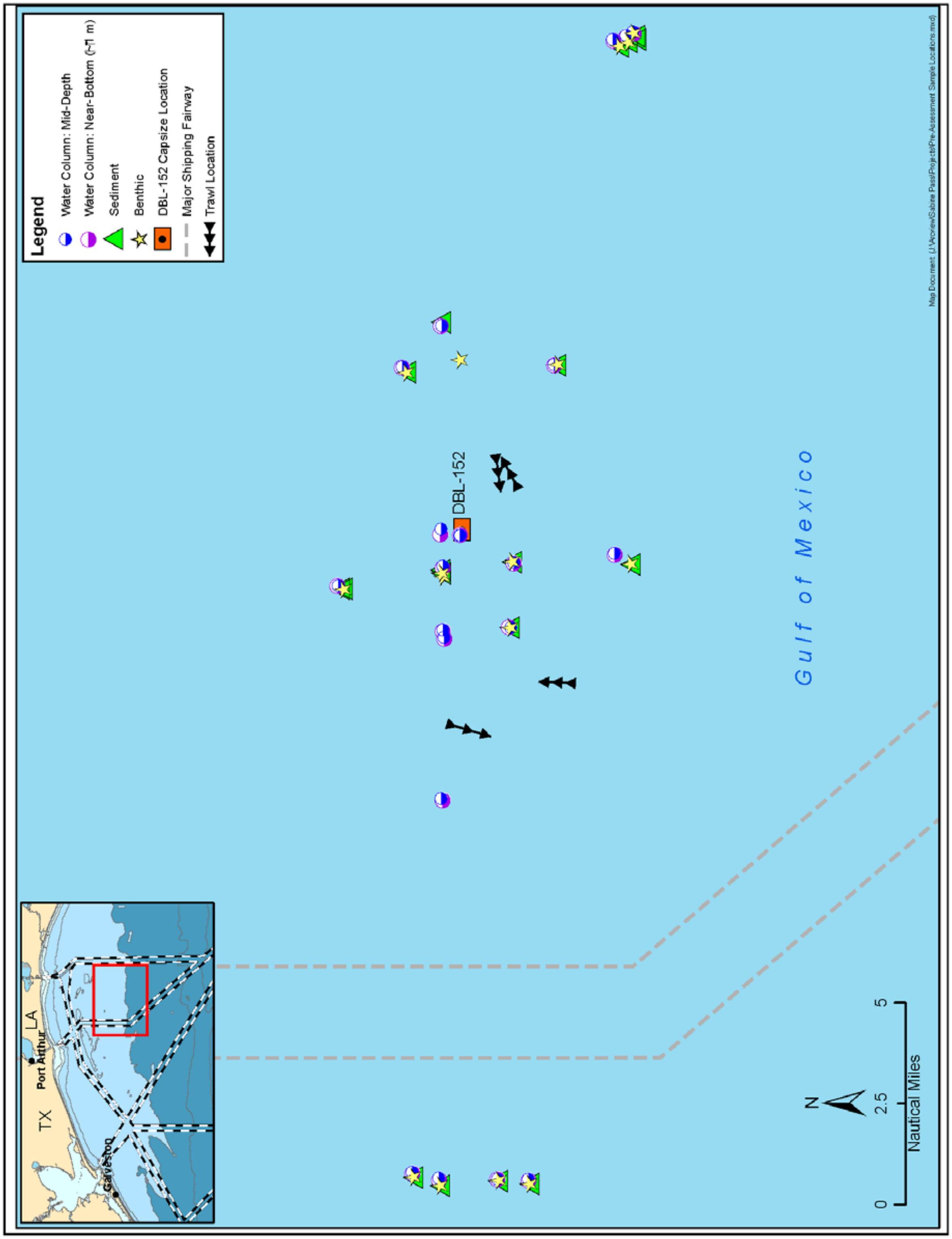


Figure 6. Preassessment water column, sediment chemistry, benthic community, and trawl sample collection locations.

Table 2. Location and description of water samples where total and/or individual PAHs exceeded NOAA's acute ambient water quality screening value in marine waters (2004).

Lab ID	Collection Date	Latitude	Longitude	Sample Description	Exceedance
ETX4846	12/26/2005	29.207197º	93.474046º	Mid water column sample taken by diver at approximately. 8 meters above oil patch. Location coordinates are approximate (lat/long are related to the location of the barge from which the sampling was staged)	Total PAHs and Phenanthrene
ETX4914	1/11/2006	29.12406º	93.28134º	Water column sample taken by diver at approximately 1 meter above oil patch; Location coordinates are approximate (lat/long are related to the location of the barge from which the sampling was staged)	Total PAHs, Phenanthrene & 2-methyl-naphthalene
ETX4915	1/11/2006	29. 12406º	93.28134º	Water column sample taken by diver at approximately 1 meter above oil patch; Location coordinates are approximate (lat/long are related to the location of the barge from which the sampling was staged)	Total PAHs and Phenanthrene
ETX4895	12/31/2005	29.20643º	93.49119º	Water sample taken by diver approximately 1	Total PAHs and Phenanthrene

Lab ID	Collection Date	Latitude	Longitude	Sample Description	Exceedance
				meter above oil patch	
ETX4892	12/31/2005	29.20643º	93.49119º	Water sample taken by diver at approximately 11 meters below water surface	Total PAHs and Phenanthrene
ETX4894	12/31/2005	29.20643º	93.49119º	Water sample taken by diver approximately 1 meter above oil patch	Total PAHs
ETX4896	12/31/2005	29.20643º	93.49119º	Water sample taken by diver approximately 1 meter above oil patch	Total PAHs
ETX4616	12/26/2005	29.137º	93.29122º	Mid water column sample taken by diver at approximately 8 meters above oil patch. Location coordinates are approximate (lat/long are related to the location of the barge from which the sampling was staged)	Total PAHs
ETX4613	11/23/2005	29.20491º	93.47913º	Water column sample taken by diver approximately 1 meter above oil patch west of T/B DBL 152 wreck site.	Total PAHs

3.3 INJURY DETERMINATION

The majority of discharged oil was denser than sea water. As a result of its density, upon release it sank to the seafloor. Injury to benthic invertebrates, demersal fishes, pelagic fishes, and marine mammals resulted from the released oil from smothering and coating of benthic resources and ingestion by animals that feed on benthic resources and demersal fishes in the affected area. Contact with oil or ingestion of oil or oiled prey may have acute or chronic effects on these organisms, including physical effects (such as smothering) and toxicological effects. Additionally, the presence of discharged oil in the environment may have caused decreased habitat utilization of the area, altered migration patterns, altered food availability, and disrupted life cycles. Natural resource services that may have been affected by the oil discharge include, but are not limited to, chemical exchange across the interface between the sea floor and the water column, decomposition and use of organic matter by benthic microalgae and other fauna, primary production, and habitat utilization by benthic and demersal fauna.

Response and NRDA data collection efforts were focused on the seafloor and its associated resources and services because these areas had the longest exposure to the submerged oil and a direct pathway for injury (i.e., smothering and coating of benthic resources and ingestion by animals that feed on benthic resources and demersal fishes). A considerable effort was undertaken to assess the nature and extent of oil on the seafloor including its distribution, thickness, fate and transport, and chemical properties. These data were used to estimate injuries to natural resources and services from this Incident.

Dispersed and dissolved polycyclic aromatic hydrocarbons (PAHs) were detected in the water column, which could have resulted in exposure of aquatic resources to the toxicological effects of PAHs. Various fishes were observed by divers and the ROV in oiled areas, but oiled fishes were not observed or recovered in the submerged oil field. Other ecosystem resources and services in the water column also may have been affected by the discharge, but NOAA declined to investigate those potential injury categories further. Based on the circumstances of this spill, including the type and amount of oil spilled and the spatial distribution, NOAA determined the potential effects to animals in most of the water column were likely short-term and of low-magnitude. Detrimental physical and toxicological effects had a low likelihood of occurring based on the ability of these animals to avoid areas of the water column with oil (e.g., marine mammals). Furthermore, no oiled animals were collected or observed on the ocean surface or water column, indicating that such injuries were unlikely to have occurred or were minimal.

No reports of lost human use were recorded, and no recreational or commercial fishing vessels were observed in the vicinity of the spill.

3.3.1 INJURY TO BENTHIC HABITAT

Benthic and demersal invertebrate and vertebrate resources had the highest potential for exposure and longest exposure to the discharged oil, especially those organisms that were immobile. After reviewing all available evidence and considering the requirements in 15 CFR 990.51, NOAA determined that benthic habitats should be included in the assessment. Upon further assessment, NOAA determined that injuries to benthic habitats and associated resources and services had, in fact, occurred.

Natural resources and services of concern: The Gulf of Mexico, and particularly seafloor habitats, contains natural resources and services of concern to NOAA, including, but not limited to, marine invertebrates, fishes and other vertebrates, and marine mammals.

Evidence indicating exposure, pathway, and injury/Mechanism by which injury occurred/Adverse change or impairment that constitutes injury: Submerged oil was documented on the seafloor using a variety of techniques during the response and during LTM (see Figure 5). Thus, the exposure of resources and services and the pathways for injuries (i.e., smothering and coating of benthic resources and ingestion by animals that feed on benthic resources and demersal fishes) are well-supported by benthic surveys.

The type, degree, spatial and temporal extent of injury: LTM surveys indicated that submerged oil discharged during the Incident was present on the seafloor of the Gulf of Mexico for more than a year. Although the submerged oil was mobile and discontinuous over the cumulative impact area, information gathered during the response and LTM was sufficient to document the presence/absence of oiling and to estimate the degree of oiling and spatial extent of oiling over time (see Figure 5).

Available assessment procedures and their time and cost requirements: A variety of methods to assess potential injuries to natural resources and services were considered, ranging from a literature review to benthic sediment chemistry and water column modeling studies. In accordance with NOAA's established guidance for injury assessment (NOAA 1996), safety and logistical considerations as well as the time and cost requirements for these studies were evaluated. During the review of methods, NOAA considered whether studies would narrow uncertainty of model/experimental parameters, support restoration scaling or possible restoration objectives, meet the scientific requirements for evidence, and generally meet a valid study design.

Potential Natural Recovery Period/Restoration Actions that are feasible: Multiple restoration actions that accelerated natural recovery periods or were available for compensatory restoration were considered by NOAA. The restoration actions considered during this assessment are described in more detail in Chapter 5.

3.4 SUMMARY OF INJURY QUANTIFICATION

NOAA first determined that measureable detrimental changes to the physical habitat quality of the seafloor occurred during this Incident. NOAA then determined that information from benthic surveys designed to assess the presence, degree, and spatial and temporal distribution of oil on the seafloor could be used to assess injuries to natural resources and services. Once NOAA determined that these data could be used to assess losses to ecosystem services, NOAA then compiled other information (discussed below) to inform injury quantification using Habitat Equivalency Analysis (HEA, NOAA 2000). HEA is a commonly used injury assessment model that assists Trustees in converting injury calculations into a "currency" that can be used to scale restoration designed to offset the injury. In this case, the interim losses (i.e., loss of ecological services from the time of injury until recovery to baseline) were quantified as lost habitat "service acre years," where a service acre year was the flow of baseline services from one acre of habitat for one year. Inputs to the HEA model were derived from data collected during the response and preassessment phase of the Incident (see Table 3).

Table 3. Summary of model inputs for HEA and injury quantification.

HEA Input	Value
Base Year	2005
Oiled Acres	45,000
Percent Cover of Oiled Acreage	1%
Estimated Service Loss	100%
Estimated Period of Injury	5 years
Shape of Recovery Curve	Linear
Annual Discount Rate	3%
Total Discounted Service Acre Years (DSAYs)	1,475

Discussion of Selected Injury Quantification Factors

Base Year: The Incident occurred in November 2005. Therefore, the base year in the HEA model is 2005, and the duration of injuries is calculated in yearly increments thereafter.

Oiled Acres: The cumulative footprint of the submerged oil field is approximately 45,000 acres (although, as discussed below, this entire area did not contain oil at all times). The footprint was generated by interpolating a line between points that indicated oiling on the perimeter of the submerged oil field. The area of the resulting polygon was calculated with mapping software. The calculated area of the cumulative footprint, which approximates a maximum footprint as of Fall 2006, is based on the best available information from extensive field surveys.

Percent Cover of Oiled Acreage: NOAA estimated an average percent cover of 1% over the 45,000 acres of the cumulative oiling footprint. As noted previously, the presence of oil within the footprint was not uniform or continuous (i.e., there was not a uniform coat of oil over all 45,000 acres). Rather, at any given time, there was oil dispersed in patches throughout the affected area. Oil also was moving along the seafloor according to prevailing currents and changing chemically over time. Not all areas of the cumulative oiling footprint were surveyed for oil every sampling period since the focus of the response and LTM effort was locating recoverable oil and identifying the leading edge of the submerged oil field. However, there was sufficient data collected (described below) to calculate an average percent cover. This was accomplished by rounding up to the nearest whole percent the adjusted discharge volume (i.e., offset for recovered oil and reduction in volume due to dissipation in the water column, etc.) spread over the cumulative oiled footprint at 0.5-inch oil depth (i.e., acre half-inches). The average percent cover and oil thickness estimates were also corroborated by underwater video imagery and observations by divers.

Calculating Percent Cover from Diver Video: Percent cover estimates within selected field transects were estimated from underwater video imagery. In portions of the seafloor where oil was detected, the percent cover usually exceeded 1%; however, the percent cover was highly variable from location to location. The average percent cover for surveyed transects ranged from zero to 21.9 percent (ENTRIX, Inc. 2010). In one heavily oiled area, the average percent cover of oiled seafloor was about six percent (ENTRIX, Inc. 2010). Ultimately, upon considering the overall variability of cover, the observed cover in certain areas, the estimated oil thickness (discussed below), and the size of the cumulative oiling footprint, NOAA estimated that the average percent cover over the entire cumulative oiling footprint approximated one percent.

Estimate of Oil Thickness: NOAA used a half-inch oil thickness in percent cover calculations based on visual estimations of oil depth from divers during the response and LTM. Oil depths on the seafloor described by divers ranged between 0.5-2.0 inches, with most observations between 1.0 and 1.5 inches (ENTRIX, Inc. 2010). The highest oil depths occurred in the most heavily oiled areas, but divers reported significant variability over space and time for oiling thickness. Therefore, NOAA selected the lowest estimate of recorded oil thickness because response and LTM operations were biased toward heavily affected areas. Further, NOAA determined that as time passed and the oil field spread out from the initial discharge point, the oil depth was more likely to approximate the lowest oil depth value (0.5 inches) provided by divers.

Calculation: NOAA started with the total amount of discharged and unrecovered oil (1,826,622 gallons) and the estimate of total area affected by oil (45,000 acres). NOAA then used 0.5 inches of oil thickness to calculate an average percent cover of 0.3%. Finally, NOAA rounded the average percent cover up to the nearest whole number of 1% to account for the fact that oiled areas usually had estimated percent covers higher than 1%. Corroborating this calculation by using another method, the analysis of selected underwater video imagery, also indicated that average percent cover values over the cumulative oiled area approximated slightly less than one percent.

Other Factors: Although neither of these methods for calculating average percent cover is fully precise, NOAA determined that the similar results of the two methods, one volume-based and the other observation-based, supported one another. Furthermore, these results are further supported by field data collected during the entire response and LTM. Finding and evaluating submerged oil offshore is difficult and expensive. NOAA determined during preassessment that conducting additional NRDA field operations to refine a percent cover estimate over the entire submerged oil field was unfavorable and not likely to contribute significant additional precision to the calculation of the average percent cover over such a large submerged oil field.

Estimated Service Loss: NOAA determined that field surveys designed to assess the presence, degree, and spatial and temporal distribution of oil on the seafloor could be used as a proxy to assess injuries to habitat and natural resource services on the seafloor. NOAA determined that heavy viscous oil covering the bottom of the seafloor reduced the habitat quality to the point where habitat services were nonexistent or negligible. Oil on the seafloor in sufficient quantities to form a film or layer of oil across the surface severely affects, amongst other things, animals on and beneath the surface, fishes and other animals that may feed on seafloor organisms or occupy areas on or near the bottom, and movement of benthic organisms. In short, offshore benthic habitat covered with a thick layer of oil is effectively unusable to the organisms it might otherwise benefit. In addition, offshore studies of seafloor ecological services are logistically and scientifically challenging and expensive, particularly given the scale of the submerged oil field (a significant factor, as the oil was mobile). Given all of these factors, NOAA chose the maximum service loss (100%), as this position was both technically reasonable and protective of the resource.

NOAA assigned this 100% service loss only to 1% of the oiled area in the cumulative oiled footprint. In other words, while the cumulative oiling footprint was approximately 45,000 acres, only about 1% of that area was covered with oil at a given time, based on the evidence discussed above. Therefore, the 100% service loss only applies to areas where oil was actually present (i.e., 1% of the cumulative oiling footprint).

Estimated Period of Injury: Since the discharged oil was mobile, and some fractions of the oil persisted in the environment for almost two years, NOAA determined that the overall recovery of oiled seafloor habitat would not begin until the submerged oil was believed to have dissipated (approximately two years after the Incident). The total recovery period in the HEA is five years because discharged oil persisted and was observed on the bottom of the ocean for about two years after the Incident, followed by a three-year biological recovery period that "started" after the oil had weathered to a point where physical fouling was unlikely. The types of animals using the sea floor for parts of their life cycles range from worms and other detritus feeders to larger animals such as bivalves, crabs, and even sea anenomes or starfish (Parker *et al.* 1980; NRC 2003). The life spans of those animals span from months to decades, with most animals potentially affected by the discharge living less than five years (Parker *et al.* 1980). For this Incident, NOAA used a 5-year recovery period in the Habitat Equivalency Analysis for benthic habitat fouled by submerged oil because it represented a qualitative median value for lost adult life span between short- and long-lived animals in the benthic community. The 5-yr habitat recovery period also takes into account a large body of ecological research that explains the mechanism of recovery in ecological communities following pollution or other habitat disturbance. That is, colonizing species or disturbance-adapted animals typically are first to recover and occupy an area, followed months to years later by other animals in the benthic community that are considered part of a mature ecosystem. In summary, for this Incident NOAA used a 5-year habitat recovery period in the HEA to account for a range of life spans of potentially affected animals associated with this portion of the sea floor of the Gulf of Mexico and for the range of habitat recovery rates as a biological response to disturbed habitat (e.g., pollution or trawling, dead zones) (NRC 2003). To account for the fact that the Incident occurred in November of 2005, full injury to the 1% of area is applied to the last 7 weeks of that year and all of 2006, with recovery beginning in 2007 and full recovery by the end of 2010.

Based on the conclusions discussed above, the HEA model indicated that 1,475 Discounted Service Acre Years (DSAYs) were lost as a result of the discharge. The quantified injuries derived using HEA were then used to identify the quantity of restoration needed to compensate for injuries (generally in the form of habitat acreage). In this case, restoration was scaled to provide comparable habitat resources and ecological services (equivalency) between the lost and restored habitat resources and ecological services. There was also a further adjustment through discounting to account for the difference in time between when services are lost and when services are gained through restoration. This process is described more fully in the next section.

3.5 SCALING OF RESTORATION

The assessment completed by NOAA (and described above) quantified the amount of restoration (in this case expressed as DSAYs) needed to compensate for the injury to resources. The next step is to select appropriate restoration projects (as discussed in Chapter 6) and to "scale" the restoration to the injury. The scale (or size) of the preferred restoration action should provide a gained value sufficient to offset the value of the losses (NOAA 1997). In other words, since 1,475 DSAYs of benthic habitat were lost, the restoration designed to compensate for this should generate ecological services equivalent to 1,475 DSAYs of benthic habitat. Just as HEA is used as an accounting procedure to allow parties to identify "debits" (estimating habitat injuries or other resource service losses) due to exposure to oil or remedial activities, it also helps identify the scale of restoration required to compensate for assessed injuries or losses. It allows the "debits" to be balanced against the ecological services to be gained (restoration "credits") from proposed habitat restoration projects.

The planned restoration action does not impact injury scaling because no primary restoration is anticipated, and because restoration will be initiated after the natural recovery period ended in 2010.

The assessed benthic resource losses are for benthic injuries occurring in soft un-vegetated bottom sediments in an offshore marine environment, also referred to as open water habitat. The restoration project proposed to compensate for these losses involves shoreline protection with rip-rap wave-breaks and creation of salt marsh (how this proposed project was chosen is discussed below in Chapter 5). To determine the amount or scale of restoration needed to offset losses, the DSAYs lost due to injuries have to be compared to DSAYs gained through restoration across these habitat types (open water versus created marsh, open water versus protected natural marsh, and open water versus rip-rap). The comparison is complicated by differences in functions or ecological productivity levels between these habitats.

To translate the habitat losses into their 'equivalent' in the target restoration habitat, it is necessary to identify a conversion factor or ratio to be used to adjust for the differences in relative productivity across these habitat types. To accomplish this, the habitat productivity of the injured open water habitat was first compared to the habitat productivity of a natural marsh. NOAA reviewed available literature and similar case histories to derive a marsh equivalency factor, accepting a ratio of 4.5 acres of offshore benthic habitat to 1 acre of tidal wetland (Peterson *et al*., 2007; Texas Natural Resource Trustees, 2000). NOAA determined that this ratio, or "marsh equivalency factor," could be used as a conversion factor for the habitats under consideration in the DBL 152 case based on an extensive review of literature relevant to the specific geographic areas impacted by the Incident and targeted for restoration. As part of this literature review, NOAA investigated whether this conversion factor would need to be adjusted based on potential differences between the productivity of offshore and nearshore benthic communities. Ultimately, NOAA concluded that the 4.5:1 ratio fell within the range of values outlined in the available literature and decided to use it without adjustment (NOAA, 2011). Similarly, NOAA derived a rip-rap equivalency factor of 0.45 acres of offshore benthic habitat for every 1 acre of rip-rap based on settled case history (DE, NJ, & PA Trustees 2009).

Applying these equivalency factors for the purpose of scaling potential restoration alternatives, the benthic equivalency factors were multiplied by the number of in-kind DSAYs provided through the creation of one acre of rip-rap or marsh habitat. That is, having calculated that 7.47 DSAYs of rip-rap productivity are gained for each acre of rip-rap habitat created, the equivalency factor of 0.45 acres of benthic habitat per acre of rip rap is applied, yielding 3.36 DSAYs of benthic productivity gained per acre of rip-rap created. Similarly, having calculated that 8.23 DSAYs of marsh productivity are gained for each acre of marsh created, the equivalency factor of 4.5 acres of benthic habitat per acre of marsh habitat is applied to determine that 37.1 DSAYs of benthic productivity are gained per acre of marsh created. The results of these calculations, termed Equivalent DSAYs (EqDSAYs), are conversions of rip-rap or marsh habitat gained through restoration to their equivalent in gained services from benthic habitat. To ensure that adequate compensation is provided by the restoration projects under consideration, the assessed losses in benthic habitat (1,475 DSAYs) can be divided by the number of EqDSAYs generated by each habitat type. The EqDSAYs to be gained from the preferred restoration action are estimated and compared to the DSAYs Lost in Section 6.1.5.

CHAPTER 4: AFFECTED ENVIRONMENT

In the response and assessment phases, NOAA's emphasis was on the areas and resources directly affected by the Incident; however, NOAA also recognized that the injured resources are part of a larger ecological system: the continental shelf of the northwestern Gulf of Mexico. Accordingly, in development of this Draft DARP/EA, appropriate restoration opportunities within that system, including the inshore estuarine areas that provide nursery habitat for many species inhabiting the continental shelf (and that are much more limited and impacted), are also considered. Under this approach, the natural resource Trustee is better able to compensate for resource injuries while also taking into account the multiple ecological and human use benefits of restoration within the larger ecosystem.

This section provides additional information, consistent with NEPA requirements, on the physical, biological and cultural environments within the northwestern Gulf of Mexico, including the offshore environment in which the Incident occurred and the Galveston Bay estuary, in which the preferred restoration action identified in this Draft DARP/EA would occur. The information in this section, together with other information in this document, provides the basis for NOAA's evaluation of the potential environmental impacts of the alternative restoration actions listed in Chapter 6 (Evaluation of Reasonable Range of Restoration Alternatives). The scope of the environmental impacts addressed in this Draft DARP/EA include those on the physical environment, the biological environment, the cultural and human environment, threatened and endangered species, and essential fish habitat.

NOAA considered the impacts of the 2010 Deepwater Horizon/BP Oil Spill (Deepwater Horizon) when characterizing the environment affected by the DBL 152 Incident as well as in selecting appropriate restoration. However, with regard to the affected environment, NOAA concluded that there were likely few, if any, overlapping impacts between the two spills. Deepwater Horizon occurred in 2010 at around the time the resources injured by the DBL 152 were approaching full recovery. In addition, the two incidents were relatively distant from each other spatially as well as temporally. The DBL 152 oil spill occurred offshore nearly due south of the Texas/Louisiana border, while the Deepwater Horizon occurred five years later offshore nearly due south of the Louisiana/Mississippi Border – over 300 miles away.

4.1 PHYSICAL ENVIRONMENT

The offshore environment of the northwestern Gulf of Mexico is characterized by a wide, shallow sloping continental shelf that extends over 100 miles offshore from the Texas-Louisiana border. The shelf reaches depths of approximately 300 feet before dropping sharply to the abyssal plain of the central Gulf of Mexico. Waters on the continental shelf in the vicinity of the Incident are heavily influenced by the Mississippi, Atchafalaya, Sabine, Neches, Trinity, and San Jacinto Rivers; these rivers constitute major sources of freshwater, sediment, nutrients, and pollutants drained from a massive area encompassing over 60% of the continental United States. Freshwater inputs from this drainage result in a freshwater lens that can extend over much of the continental shelf depending on flow volumes, and nutrient inputs from this drainage are the source of a well-documented hypoxic zone in nearshore areas extending from the Mississippi delta region to the Texas-Louisiana border and occasionally beyond. Hypoxic events are seasonally influenced. The continental shelf in the vicinity of the Incident consists primarily of soft mud and sand bottoms with scattered rocky outcroppings and banks, the most notable of which result from geologic upwellings known as salt domes. Wind in the vicinity of the Incident is predominantly from the southeast, and currents in the vicinity of the Incident are dominated by an anticyclonic gyre moving westward along the Louisiana and Texas coasts from the Mississippi delta region to south of Corpus Christi, Texas. The sediment loading of nearshore waters is significant to the regional coastal ecology due to the highly erosive nature of many onshore habitats and the importance of sediment resources for maintaining the stability of inshore areas in the context of regional sea level rise and subsidence (see Figure 7, below).

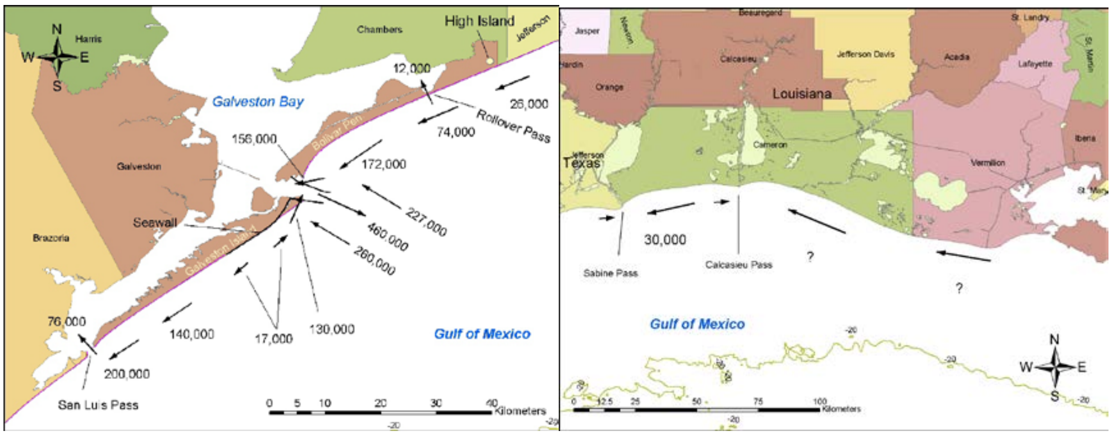


Figure 7. Sediment movement along the coast of southwestern Louisiana and southeast Texas. Arrows show the direction of sediment movement, and numbers represent net transport in cubic meters per year (USACE 2007).

The inshore environment of the region is characterized by a subtropical climate with over 50 inches of rainfall annually. Tropical and frontal weather events punctuate predominant weather patterns (hot, humid summers and cool, wet winters) and shape the landscape, which features the extremely low-lying topography of the coastal plain (dominated by prairies and marshes), river valleys (forested riparian corridors), and chenier ridges. The geology of the coastal zone is relatively recent and sedimentary; current geomorphology of the region is characterized by a sediment deficit and resultant shoreline retreat. Current estuarine systems resulted from flooding of former river valleys over geologic time. Relative sea level rise (the combination of localized subsidence and global eustatic sea level rise) is significantly impacting processes of sedimentation and erosion in the region, and hydrologic modifications to riverine systems are exacerbating these effects. Flooding and freshwater inflows are important in maintaining salinity gradients and nutrient levels that support extremely high biological productivity in the estuarine systems in the region. East Galveston Bay, where the preferred restoration project alternative is located, averages approximately eight feet in depth.

4.2 BIOLOGICAL ENVIRONMENT

The communities comprising the biological environment of the offshore continental shelf in the vicinity of the Incident are characterized by the oceanic zone they inhabit (i.e., benthic infauna, demersal fish and macroinvertebrates, coastal or highly migratory pelagic fish, sharks, or marine mammals, and plankton). The benthic community in this area, which was considered to have sustained the greatest injury as a result of the Incident, is significantly affected by abiotic factors such as salinity, temperature, organic content and grain size of bottom sediments, wave energy, and dissolved oxygen. The natural variability in these factors results in a rapid turnover rate in benthic infaunal or epifaunal populations. Polychaetes and mollusks contribute most significantly to the abundance and diversity of species in the area. The preferred restoration project alternative lies within the Gulf Prairie and Marsh ecological region (which extends along the Texas coast from the Sabine River south to the Rio Grande), and within a bio-geographical region known as the Chenier Plain (which extends from Vermillion Bay in southwestern Louisiana to East Galveston Bay in southeastern Texas). This coastal ecosystem includes tidal, micro-tidal and freshwater coastal marshes; bays and lagoons which support extensive seagrass beds, tidal flats, and oyster reefs; and forested riparian habitats. Chenier ridges are distinguishing features of the region which are ridges representing ancient Gulf shorelines and are generally aligned parallel to the Gulf or as fan-shaped alluvial deposits at the mouths of rivers. The higher cheniers support woody vegetation. Cheniers are more prevalent in Louisiana than in Texas, perhaps because of the alignment of the Gulf shoreline and its proximity to the Mississippi River, the Chenier Plain region's primary sediment source. The coastal marshes and other habitats of the Chenier Plain region of southwestern Louisiana and southeast Texas feature globally significant biodiversity. Avian diversity in the area is extremely high; some 600 of the 800 avian species inhabiting North America are resident to or migrate through the area annually. Marine and estuarine species diversity is similarly high.

The upper Galveston Bay watershed supports a diverse assemblage of aquatic life, including plants (both vascular and non-vascular) and animals (invertebrates, fish, mammals, reptiles, etc.). These organisms depend upon the watershed to provide habitat for foraging, mating, rearing young, and other important life functions. Several of the organisms found within the Galveston Bay system are among those vital to the economy of Texas, as well as a significant element of outdoor recreational opportunities. The waters of East Galveston Bay support species important for commercial and recreational usage and provide habitat for the following organisms: white shrimp (*Litopenaeus setiferus*) and brown shrimp (*Farfantepenaeus aztecus*), blue crab (*Callinectes sapidus*), eastern oyster (*Crassostrea virginica*), spotted seatrout (*Cynoscion nebulosus*), sand seatrout (*Cynoscion arenarius*), Atlantic croaker (*Micropogonius undulatus*), red drum (*Scienops ocellatus*), black drum (*Pogonius cromis*), southern kingfish (*Menticirrhus americanus*), Gulf kingfish (*Menticirrhus littoralis*), sheepshead (*Argosargus probatocephalus*), southern flounder (*Paralichthyes lethostigma)*, striped mullet (*Mugil cephalus*), sea catfish (*Galeichthys felis*), Gulf menhaden (*Brevoortia patronus*), and gafftopsail catfish (*Bagre marinus*). In addition, numerous other estuarine and marine resources are found in San Jacinto River and Upper Galveston Bay Estuary including bay anchovy *(Anchoa mitchilli*), silver perch (*Bairdiella chrysoura*), bull shark (*Carcharhinus leucas*), sheepshead minnow (*Cyprinodon variegatus*), gizzard shad (*Dorosoma cepedianum*), Gulf killifish (*Fundulus grandis*), code goby (*Gobiosoma robustum*), pinfish (*Lagodon rhomboides*), spot (*Leiostomus xanthurus*), silversides (*Menidia* spp.), Gulf flounder (*Paralichthys albigutta*), Spanish mackerel (*Scomberomorus maculatus*), bay squid (*Lolliguncula brevis*), hard clam (*Mercenaria mercenaria*), grass shrimp (*Palaemonetes pugio*), and common rangia (*Rangia cuneata*).

Estuarine organisms of commercial, recreational and ecological importance typically have inshore and offshore components of their life histories. Many species in the Galveston Bay estuary spawn offshore or near estuary passes, and their larvae or post larvae migrate into the estuarine nursery area to grow and develop prior to offshore migration and maturation. The oyster is the exception in that it is completely estuarine. Other taxa such as birds, reptiles, and mammals use estuarine habitats for feeding, refuge, and reproduction. Many estuarine dependent species of fish are harvested from Galveston Bay including: flounder; Atlantic croaker; spotted seatrout, sand sea trout; and red drum. In addition, five species of invertebrates (oysters, blue crabs, and three penaeid shrimps) are harvested from the Galveston Bay estuary. During their juvenile stages, these organisms utilize estuarine habitats such as marshes, seagrass beds, oyster reefs and mudflats for feeding and protection. Many species are more abundant in vegetated habitats such as emergent marshes and submerged aquatic vegetation than in adjacent non-vegetated habitats. Fishery production is directly proportional to wetlands acreage. The sediments within the Greens Bayou watershed and Upper Galveston Bay Estuary support benthic organisms, including annelid worms, small crustaceans (amphipods, isopods, copepods, and juvenile decapods), mollusks, and other small bottom-dwellers in salt marshes and unvegetated subtidal sediments. Among these benthic organisms are herbivores (eating algae or other live plant material), detritivores (feeding on decaying organic matter in surface sediments or sediment-bound nutrients and organic substances that are not generally available to epiphytic or pelagic organisms), carnivores (preying on other benthic organisms), and omnivores (a combination). These organisms provide the nutritional base for developing stages of many finfish and shellfish and, thus, affect all trophic levels in East Galveston Bay. The activities of benthic organisms are important in conditioning wetlands and subtidal habitats and in the decomposition and nutrient cycling that occur in these areas. In sum, benthic communities provide important ecological services primarily related to food production, decomposition and energy cycling that affect nearly all organisms within an estuarine system. A potential adverse impact on benthic populations has the potential to impact biota in nearly all trophic levels of the lower Galveston Bay estuary. The shorelines of East Galveston Bay are home to a variety of plant species which are typical of species found in estuarine wetlands, including cordgrasses (*Spartina alterniflora* and *S. patens*), saltwort (*Batis maritima*), glass wort (*Salicornia virginica*), seashore saltgrass (*Distichlis spicata*), saltmarsh bulrush (*Scirpus maritimus*), sea oxeye (*Borrichia frutescens*), and marsh elder (*Iva frutescens*).

Sea level rise and land subsidence are contributing to coastal land loss and habitat degradation in the region, and pose significant threats to the future viability of these important coastal habitats. Development and land use changes have also resulted in loss of native habitats, loss of biological diversity, and decreased habitat quality for migratory birds and other native wildlife. Coastal marshes have been impacted by major alterations of historic hydrology including loss of freshwater and sediment inflows and increased saltwater intrusion. The Gulf Intracoastal Waterway (GIWW), the Houston Ship Channel and the Sabine-Neches Ship Channel are major public works projects that have greatly affected hydrology of coastal marshes in the project area. Collectively, altered hydrological regimes resulting in saltwater intrusion, reduction of mineral sediment supply to littoral and marsh systems, sea level rise and land subsidence are resulting in coastal erosion and shoreline retreat along the Gulf of Mexico and bay shorelines and the conversion of interior vegetated marshes to open water. Air and water quality issues in the region pose a potential contaminant threat to fish and wildlife resources. Habitat losses to date and ongoing threats are such that intensive management of remaining habitats in combination with large-scale restoration are required to ensure conservation of the Chenier Plain region's valuable coastal natural resources.

4.3 CULTURAL ENVIRONMENT AND HUMAN USE

Federal waters near the Incident are relatively undeveloped and human use is limited to recreational and commercial fishing and oil and gas exploration and production. The preferred restoration project alternative site is located on the east side of Galveston Bay, in Chambers County, Texas. The regional economy centers around the city of Houston. Despite the heavy urban development characterizing the Houston region, the East Galveston Bay shoreline in Chambers County remains predominantly rural and undeveloped. The primary human uses of the area are for agriculture (cattle, rice) and commercial fishing (particularly for oysters). The entire region was primarily focused on rice farming and cattle ranching until it was transformed in the early 1900's by the discovery of oil at Spindletop in Beaumont, Texas. The region was further changed in 1914 with the development of the Houston Ship Channel (HSC) by dredging Buffalo Bayou to a depth of 25 ft and extending the channel through Galveston Bay to the city of Galveston, the region's primary port at the time. Between 1920 and 1940, the region developed into a major petrochemical complex and shipping center. The most significant alteration to East Galveston Bay during this time was the dredging of the Gulf Intracoastal Waterway. The HSC is home to 150 companies and in 2006 it facilitated the entry and exit of a total of 7,550 vessels to the Port of Houston (PHA website). The Port of Houston is one of the busiest in the US, and currently ranks number 1 in terms of foreign waterborne tonnage shipped, second in total waterborne tonnage, and tenth in total waterborne tonnage in the world. Houston has developed into the 4th largest city in the United States and the population of the Houston metropolitan area is approaching 5 million people. In addition to its role in Texas' commercial/industrial economy, East Galveston Bay directly influences the region's recreational and commercial fishing industries. Recreational fishing occurs throughout the estuary, and the primary species fished include blue crab, red drum, black drum, spotted sea trout, southern flounder and Atlantic croaker. The East Galveston Bay area supports several important commercial fisheries. Large quantities of shrimp, oysters, and blue crab are harvested in East Galveston Bay, as well as in the surrounding salt marshes and throughout the rest of the estuary. White shrimp, brown shrimp, and eastern oysters are economically important species found in the system. Commercial harvest of finfish also occurs at low levels. These human activities are dependent upon the condition of the coastal and marine habitats.

4.4 THREATENED AND ENDANGERED SPECIES

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§1531, *et seq*.) requires federal agencies to conserve endangered and threatened species and to conserve the ecosystems upon which these species depend. Table 4 provides a list of federally recognized endangered or threatened species, as well as species utilizing designated critical habitat, reported to reside in or migrate through federal waters of the Gulf of Mexico or the preferred restoration project alternative area. Numerous endangered and threatened species are seasonal or occasional visitors to the Incident location or to the East Galveston Bay coastal ecosystem. Species present near the preferred restoration project alternative site would be present incident to migration through the area. While individual animals may have been put at risk due to the discharge of oil from the DBL 152, the continued existence of species protected under the ESA was never considered to have been jeopardized by the Incident, nor was any evidence of injury to threatened or endangered species found to have resulted from the Incident. The habitats in the

Incident location and the preferred project site provide multiple ecosystem services supporting threatened and endangered species migrating through or utilizing these communities.

Table 4. Species listed as Threatened or Endangered under the ESA in federal waters of the Gulf of Mexico or the preferred restoration project alternative area.

Common Name	Scientific Name	Federal Status
brown pelican	*Pelecanus occidentalis*	Recovery
piping plover	*Charadrius melodus*	Threatened
green sea turtle	*Chelonia mydas*	Threatened
West Indian manatee	*Trichechus manatus*	Endangered
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
leatherback sea turtle	*Dermochelys coriacea*	Endangered

4.5 <u>ESSENTIAL FISH HABITAT</u>

Congress enacted amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (PL 94-265) in 1996 that established procedures for identifying Essential Fish Habitat (EFH) and required interagency coordination to further the conservation of federally managed fisheries. Rules published by NOAA's National Marine Fisheries Service (NMFS) (50 CFR 600.805 – 600.930) specify that any federal agency that authorizes, funds or undertakes, or proposes to authorize, fund, or undertake an activity which could adversely affect EFH is subject to the consultation provisions of the MSFCMA as described in the implementing regulations. This section and the associated impacts sections were prepared to meet these requirements.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." When referring to estuaries, it is further defined as "all waters and substrates (mud, sand, shell, rock and associated biological communities) within these estuarine boundaries, including the sub-tidal vegetation (seagrasses and algae) and adjacent tidal vegetation (marshes and mangroves)" (Gulf of Mexico Fishery Management Council (GMFMC), 1998, 2005). The injury site associated with the DBL 152 Incident, the preferred restoration project site, and the alternative restoration project sites are located in areas that have been identified by the GMFMC and by the NMFS as EFH for a suite of species identified in Table 5. Categories of EFH in the vicinity of the Incident include non-vegetated marine mud, sand, and shell substrates and marine water column. Categories of EFH in the vicinity of the preferred and alternative compensatory restoration sites include estuarine emergent wetlands; estuarine mud, sand and shell substrates; and estuarine water column.

Detailed information on EFH for federally managed shrimp, crab, red drum, reef fish, and coastal migratory pelagic species is provided in the 2005 amendment of the fishery management plans (FMPs) for the Gulf of Mexico prepared by the GMFMC. Information on EFH for most highly migratory species is contained in Appendix B of the 2006 Final Consolidated Atlantic Highly Migratory Species Fishery Management Plan prepared by the NMFS. Table 5 includes a list of species and life stages for which EFH has been designated in the vicinity of the Incident and in the preferred restoration project area.

In addition to being designated EFH for the federally managed species listed below, the subtidal and intertidal zones of the preferred restoration project area also provide nursery and forage habitats that support various life stages of ecologically and recreationally important marine fishery species such as spotted seatrout, southern flounder, grey snapper, Atlantic croaker, black drum, Gulf menhaden, striped mullet, blue crab, stone crab, pink shrimp, spot, pinfish, sheepshead, gizzard shad, bay anchovy, sheepshead minnow, Gulf killifish, and silversides. Such organisms serve as prey for other fish managed under the MSFCMA by the GMFMC (e.g., red drum, mackerels, snappers, and groupers) and for highly migratory species managed by the NMFS (e.g., billfishes and sharks). Vegetated intertidal and subtidal habitats also provide important fishery support functions, including: (1) providing a physically recognizable structure and substrate for refuge and attachment above and/or below the water and sediment surfaces; (2) improving water quality by trapping sediments and assimilating pollutants; (3) preventing erosion; (4) collecting organic and inorganic material by slowing currents; and (5) providing nutrients and detrital matter to the estuarine system. Moreover, Galveston Bay provides habitat for many benthic animals, including marine worms and crustaceans which are consumed by higher trophic level predators such as shrimp, crabs, and black drum. Benthic organisms also have a key role in the estuarine food web because they (1) mineralize organic matter, releasing important nutrients to be reused by primary producers; (2) act as trophic links between primary producers and primary consumers; and (3) aggregate dissolved organics within estuarine waters, which are another source of particulate matter for primary consumers.

The preferred project would also benefit supratidal areas including irregularly flooded halophytic marsh, estuarine sandflats, and algal flats. When flooded by seasonal high tides and storm events, these areas provide nursery, foraging, and refuge habitats for marine fisheries. They also provide vital support functions necessary for the maintenance of healthy estuaries including improving water quality and producing nutrients and detrital matter. Halophytic wetlands and estuarine flats also provide habitats for a variety of marine invertebrates, which are important components of the estuarine food web.

Table 5. Reef Fish, Red Drum, Shrimp, and Coastal Migratory Pelagic Fish With Essential Fish Habitat Near the Incident or Restoration Site[1]

Species	Life Stage	Habitats[2]
Almaco jack	Early Juvenile Late Juvenile	nearshore and offshore drift algae, 15-160m nearshore and offshore drift algae, 15-160m
Dog Snapper (*Lutjanus jocu*)	Eggs Larvae Early Juvenile	nearshore pelagic nearshore pelagic marsh
Gray mangrove snapper (*Lutjanus griseus*)	Adults	marsh; estuarine, nearshore and offshore sand/shell, soft bottom, 0-180m
Gray triggerfish (*Balistes capricus*)	Larvae Post Larval Early Juvenile Late Juvenile Adults Spawning adults	nearshore drift algae nearshore drift algae nearshore drift algae nearshore drift algae, 10-100m nearshore and offshore sand/shell, 10-100m nearshore and offshore sand/shell, 10-100m
Greater amberjack	Eggs	offshore pelagic, 1-360m

(*Seriola dumerili*)	Larvae Post Larval Early Juvenile Late Juvemile Adults Spawning adult	offshore pelagic, 1-360m offshore pelagic, 1-360m nearshore and offshore drift algae, 1-360m nearshore and offshore drift algae, 1-360m nearshore and offshore pelagic, 1-360m offshore pelagic, 1-360m
Lane Snapper (*Lutjanus synagris*)	Eggs Early Juvenile Late Juvenile Adults	offshore pelagic, 4-132m estuarine and nearshore sand/shell and soft bottom, 0-20m estuarine and nearshore sand/shell and soft bottom, 0-20m nearshore and offshore sand/shell, 4-132m
Red snapper (*Lutjanus campechanus*)	Eggs Larvae Early Juvenile Late Juvenile Spawning Adults	offshore pelagic, 18-37m nearshore and offshore pelagic, 18-37m nearshore and offshore soft bottoms and sand/shell, 17-183m nearshore and offshore soft bottoms and sand/shell, 20-46m offshore sand/shell, 18-37m
Red Drum (*Sciaenops ocellatus*)	Eggs Larval Post Larval Early Juvenile Late Juvenile Adults Spawning Adults	nearshore pelagic estuarine soft bottom estuarine soft bottom and sand/shell, marsh estuarine soft bottom, marsh estuarine sand/shell, marsh estuarine and nearshore soft bottom and sand/shell, marsh, nearshore pelagic estuarine and nearshore soft bottom and sand/shell
Brown Shrimp (*Farfantepenaeus aztecus*)	Eggs Larvae Post Larval Early Juvenile Late Juvenile Adults Spawning Adults	offshore sand/shell and soft bottoms offshore pelagic marsh, oyster reef, estuarine sand/shell and soft bottom marsh, oyster reef, estuarine sand/shell and soft bottom marsh, oyster reef, estuarine sand/shell and soft bottom nearshore and offshore sand/shell and soft bottoms offshore sand/shell and soft bottoms
White Shrimp (*Litopenaeus setiferus*)	Eggs Larvae Post Larval Early Juvenile Late Juvenile Adults Spawning Adults	offshore sand/shell and soft bottoms nearshore pelagic marsh, estuarine soft bottom marsh, estuarine soft bottom marsh, estuarine soft bottom nearshore soft bottoms nearshore soft bottoms
Cobia (*Rachycentron canadum*)	Eggs Larvae Post Larval Early Juvenile Late Juvenile Adults Spawning Adults	nearshore pelagic offshore pelagic nearshore and offshore pelagic nearshore and offshore pelagic nearshore and offshore pelagic nearshore and offshore pelagic nearshore and offshore pelagic
King Mackerel (*Scomberomorus cavalla*)	Eggs Larvae Early Juvenile Late Juvenile Adults Spawning Adults	offshore pelagic offshore pelagic nearshore and offshore pelagic nearshore pelagic nearshore and offshore pelagic offshore pelagic

Highly Migratory Species With Essential Fish Habitat Near the Incident or Restoration Site[3]

Species	**Life Stage**	**Habitats[2]**
Scalloped Hammerhead	neonate/young of year	estuaries, nearshore, and offshore

(*Sphyrna lewini*)		
Bull Shark (Ca*rcharhinus leucas*)	neonate/young of year juvenile adult	estuaries, nearshore, and offshore estuaries, nearshore, and offshore estuaries, nearshore, and offshore
Lemon Shark (*Negaprion brevirostris*)	juvenile	estuaries, nearshore, and offshore
Bonnethead Shark (*Sphyrna tiburo*)	neonate/young of year juvenile	estuaries, nearshore, and offshore estuaries, nearshore, and offshore
Atlantic Sharpnose Shark (*Rhizoprionodon terraenovae*)	neonate/young of year juvenile adult	estuaries, nearshore, and offshore estuaries, nearshore, and offshore estuaries, nearshore, and offshore
Finetooth Shark (*Carcharhinus isodon*)	juvenile adult	estuaries, nearshore, and offshore estuaries, nearshore, and offshore
Blacktip Shark (Ca*rcharhinus limbatus*)	neonate/young of year juvenile adult	estuaries, nearshore, and offshore estuaries, nearshore, and offshore estuaries, nearshore, and offshore

[1] Gulf of Mexico Fishery Management Council. 2004. Final environmental impact statement for the generic amendment to the following fishery management plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, United States Waters; Red Drum Fishery of the Gulf of Mexico; Reef Fish Fishery of the Gulf of Mexico; Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic; Stone Crab Fishery of the Gulf of Mexico; Spiny Lobster in the Gulf of Mexico and South Atlantic; Coral and Coral Reefs of the Gulf of Mexico. Gulf of Mexico Fishery Management Council. Tampa, FL.

[2] The water column is considered EFH for all listed life stages.

[3] NMFS. 2009. Final Amendment 1 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan, Essential Fish Habitat. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. Public Document. pp. 395.

CHAPTER 5: THE RESTORATION PLANNING PROCESS

The goal of restoration under the OPA is to restore natural resources injured by discharges of oil to the condition that they would have been in if the Incident had not occurred. Pursuant to the OPA NRDA regulations, this goal is achieved by, to the extent practicable, restoring to baseline the natural resources that were injured and compensating for interim losses of those resources by restoring other resources of a similar type and quality or which provide a similar type and quality of ecological services.

NOAA determined that, due to the specific circumstances of this Incident, the impacted area has likely recovered to baseline conditions naturally over a relatively short time. In addition, due to the off-shore location of the spill, any primary restoration would be extremely expensive relative to the benefit it would provide. Thus, active primary restoration was considered by NOAA, but it was decided that such activities would not contribute significantly to the recovery of the injured area. Therefore, the focus of this chapter of the Draft DARP/EA is on compensatory restoration actions for the DBL 152 Incident.

5.1 RESTORATION STRATEGY

Restoration actions are defined as primary or compensatory. "Primary" restoration actions are actions that restore injured resources to their baseline condition (that is, their condition prior to the release of oil). Natural recovery, in which no human intervention is taken to restore the injured resources, is considered a primary restoration alternative, and 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.

Restoring the injured resources through primary restoration does not fully compensate the public for the injury, since there is always some period of time from initial injury until full recovery of natural resources to their baseline condition. During this "interim" period, the injured resources are providing less than their baseline level of services; therefore, the reduced level of services during this time is known as "interim loss." Primary restoration cannot compensate the public for these interim losses, so some other restoration is necessary to accomplish that task. Restoration to compensate for interim losses – or "compensatory restoration" – is often conducted by restoring resources that were not directly injured by a discharge of oil but are of a similar type or provide similar ecological services. The scale of the 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.

5.2 EVALUATION CRITERIA

Pursuant to the OPA NRDA regulations (15 CFR 990.54), NOAA evaluated the identified restoration alternatives based on the following criteria, presented in the order given in the regulations:

1) **Cost to carry out the alternative:** This criterion considers the cost associated with implementation of the restoration project relative to expected resource and service benefits. Projects that provide similar benefits but that are less expensive are preferred.
2) **Extent to which each alternative is expected to meet NOAA's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses:** The primary goal of any compensatory restoration project is to provide a level and quality of resources and services comparable to those lost due to the assessed injuries. In meeting that goal, NOAA considers, among other things, the potential relative productivity of the habitat to be restored, whether the habitat is being created or enhanced, proximity to the injury, and the type of resources being restored. The location and type factors are commonly referred to as "nexus" criteria.
3) **Likelihood of success of each alternative:** NOAA considers technical factors that represent risk to successful project construction, project function, or long-term viability of the restored habitat. This includes site-specific factors, such as whether a project is technically and procedurally sound, utilizes proven methods, involves sufficient acreage that is suitable and available for project implementation, and whether there are potential institutional or legal constraints. Alternatives that are susceptible to future degradation or loss as a result of factors such as erosion are considered less viable. NOAA also considered whether long-term maintenance of the project is likely to be necessary and/or feasible.
4) **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:** Restoration actions should not result in additional losses of natural resources and should minimize the potential to affect surrounding resources during implementation. Projects with less potential to adversely impact surrounding resources are generally viewed more favorably. Compatibility of the project with the surrounding land use and potential conflicts with endangered species are also considered.
5) **Extent to which each alternative benefits more than one natural resource and/or service:** This criterion addresses the interrelationships among natural resources, and between natural resources and the services they provide. Projects that provide benefits to more than one resource and/or yield more beneficial services overall, are viewed more favorably. For example, although recreational benefits are not an explicit objective in this Draft DARP/EA, the potential for a restoration project to enhance recreational use of an area was considered favorably.
6) **Effect of each alternative on public health and safety:** Projects that would negatively affect public health or safety are not appropriate.

Based on the criteria listed above, NOAA compiled a preliminary list of potential restoration alternatives. NOAA screened these alternatives to select the restoration alternative best suited to compensate the public for losses of natural resources and services from the DBL 152 Incident. Section 5.3 describes the selection process. Sections 5.4 through 5.6 provide detailed information on the preferred alternative and the non-preferred alternatives.

5.3 SCREENING OF THE RESTORATION ALTERNATIVES

The OPA NRDA regulations give NOAA discretion to prioritize the above criteria and to use additional criteria as appropriate. In developing this Draft DARP/EA, the second criterion listed (the extent to which each alternative is expected to return injured resources to baseline and/or compensate for interim losses) has been a primary consideration, because it is paramount to ensure that the restoration action will compensate the public for the injuries to offshore benthic resources impacted by the Incident.

NOAA identified seven restoration alternatives that exhibited sufficient geographic and ecological nexus to the injured habitat to warrant a full analysis. The preference under OPA is for in-kind restoration (restoration of resources identical or similar to those injured) where possible and otherwise consistent with the criteria listed in Section 5.2. However, in-kind restoration was deemed to be infeasible. The restoration of offshore benthic and water column habitats is exceptionally logistically challenging and prohibitively expensive, given the circumstances of this Incident and relative benefits that it would provide. Accordingly, the identified restoration alternatives were primarily those that could be implemented in inshore estuarine environments. While at least one offshore habitat restoration alternative was considered, the most feasible alternatives were those that compensated for the injury through the creation, enhancement, or protection of coastal wetlands. While this restoration is out-of-kind, such a project is appropriate under the OPA NRDA regulations, 15 CFR 990.53(d)(2), if the restoration can provide equivalent services to those that were lost. Considered in light of this service-to-service scaling approach, wetlands restoration generally, and the preferred alternative specifically, were considered to have a strong nexus to the injured resource. This is due to the projects' geographic proximity to the injury site (alternatives were considered from Galveston Bay to Sabine Lake) and the fact that the majority of organisms that inhabit the offshore habitats of the continental shelf must spend some part of their life cycles in in-shore, estuarine habitats such as those proposed for restoration.

5.4 RANGE OF REASONABLE ALTERNATIVES

The restoration alternatives ranged in scope and design from capping contaminated offshore sediments to shoreline protection and marsh creation (see Figure 8). The following are brief descriptions of the projects identified as alternatives to compensate for injuries associated with oil released from the T/B DBL 152, followed by a summary of each project's ability to satisfy the project selection criteria listed in the OPA NRDA regulations:

- ***Preferred Alternative** - Shoreline protection and salt marsh creation at the Texas Chenier Plain National Wildlife Refuge Complex*: This alternative involves construction of an offshore breakwater and restoration of salt marsh through vegetation planting and passive sediment deposition, grading, or placement of fill material to achieve a shallow slope on the north shoreline of East Galveston Bay.
- *Capping contaminated sediments beneath offshore production platforms*: This alternative involves capping offshore contaminated sediments (soft mud bottoms) with clean material at the bases of inactive offshore oil and gas production platforms in the vicinity of the Flower Garden Banks National Marine Sanctuary.
- *Pierce Marsh Restoration*: This alternative involves the beneficial use of dredged material to restore intertidal elevations in a subsided salt marsh complex on the north shoreline of West Galveston Bay.

- *Snake Island Cove Submerged Aquatic Vegetation Restoration*: This alternative involves the construction of a breakwater to create a quiescent area with reduced wave energy and turbidity, within which passive recruitment of submerged aquatic vegetation would be possible, in Snake Island Cove adjacent to the west end of Galveston Island.
- *Delehide Cove/Starvation Cove Marsh Restoration*: This alternative involves the placement of dredged material to restore intertidal elevations in a subsided and eroding salt marsh complex on the south shoreline of West Galveston Bay, followed by vegetation planting.
- *Bessie Heights Marsh Restoration*: This alternative involves salt marsh restoration through either terracing or dredged material placement to restore intertidal elevations in a subsided marsh complex near the confluence of the Neches River and Sabine Lake, followed by vegetation planting.
- *Old River Cove Shoreline Protection and Marsh Restoration*: This alternative involves construction of an offshore breakwater and restoration of salt marsh through vegetation planting and passive sediment deposition, grading, or placement of fill material to achieve a shallow slope at the north end of Sabine Lake.

The preferred restoration alternative is the shoreline protection and salt marsh restoration at the Texas Chenier Plain National Wildlife Refuge Complex. Section 6.0 provides further information regarding the basis for choosing the preferred restoration alternative and the evaluation of the remaining non-preferred alternatives.

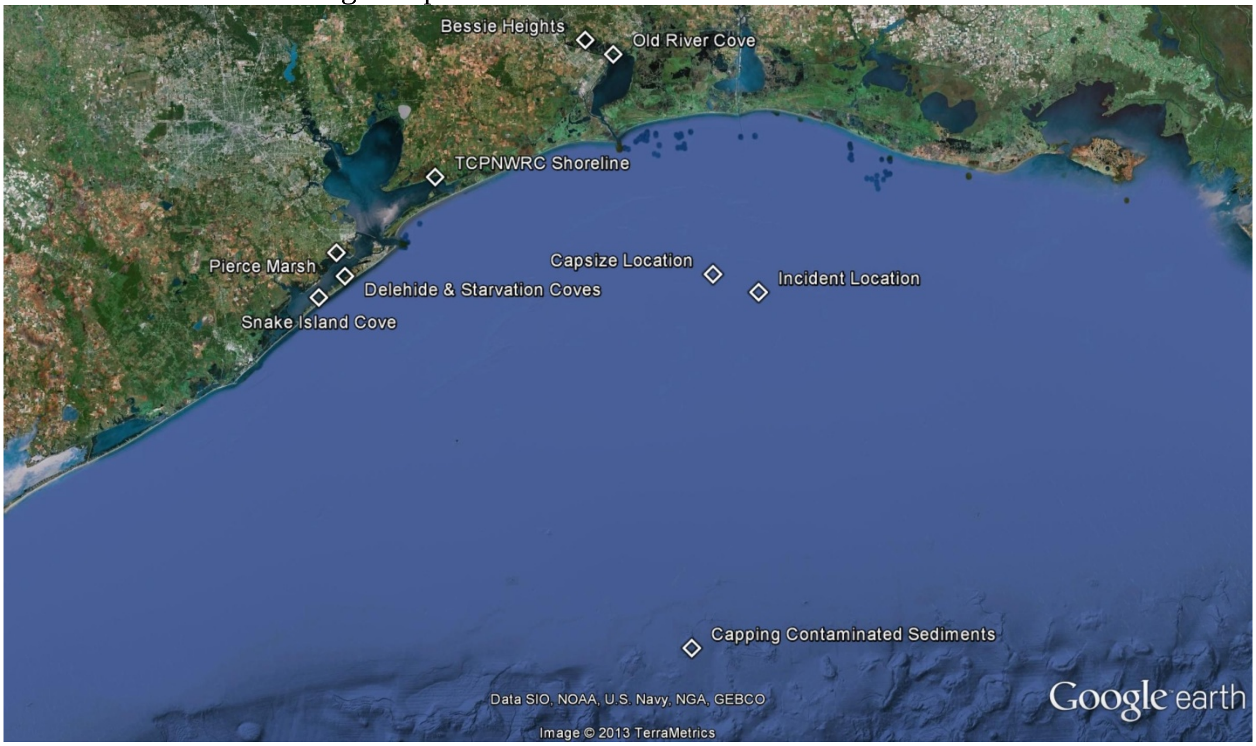


Figure 8: Approximate location of restoration project alternatives that were considered.

The preferred restoration alternative is shoreline protection and salt marsh restoration at the Texas Chenier Plain National Wildlife Refuge Complex. Section 6.0 provides further information regarding the basis for choosing the preferred restoration alternatives and the evaluation of the remaining non-preferred alternatives.

CHAPTER 6 EVALUATION OF REASONABLE RANGE OF RESTORATION ALTERNATIVES

A detailed evaluation of the preferred restoration alternative and brief evaluations of the non-preferred alternatives are provided in the following subsections.

6.1 SUMMARY OF PREFERRED ALTERNATIVE

The compensatory restoration alternative preferred by NOAA following the application of the evaluation criteria presented in Section 5.2 is shoreline protection and salt marsh restoration on the Texas Chenier Plain National Wildlife Refuge Complex. The description and analysis of the project below, as well as how the restoration project was scaled to restore natural resource and service injuries, are based on a project-specific preliminary design concept rather than detailed engineering plans. If the alternative is selected in the Final DARP/EA, the project will undergo pre-project engineering to design the shoreline protection structure and the marsh. Should significant changes in the project concept, scope, resulting benefits, compliance with environmental regulations, or cost arise during the detailed engineering and design of the project, NOAA may re-evaluate its preference for this alternative.

6.1.1 RESTORATION SITE LOCATION AND CHARACTERISTICS

The preferred restoration alternative identified by NOAA consists of shoreline protection and salt marsh restoration on the northern shoreline of East Galveston Bay in the Texas Chenier Plain National Wildlife Refuge Complex (TCPNWRC). The project area is located between Smith Point and High Island in Chambers County, Texas (see Figure 9, below). The TCPNWRC Management Plan targets nine miles of shoreline for protection, with an estimated 12,400 feet facing East Galveston Bay and 34,700 feet east of Oyster Bayou on the Gulf Intracoastal Waterway (GIWW). The project will be designed to protect at least 4.23 miles of shoreline. The protective structure will consist of 8.97 acres of rip-rap habitat, and 11.55 acres of salt marsh habitat will be created behind the breakwater. The project will also protect 8.5 acres of existing salt marsh over its lifetime. The protection of 4.23 miles of shoreline and associated habitat creation has been estimated sufficient to compensate the public for injuries arising from the DBL 152 Incident. The East Galveston Bay shoreline of the TCPNWRC comprises more than sufficient area for the preferred restoration alternative. Scouring by wind-driven waves has resulted in erosive bluffs up to 3 feet in height and very patchy remnants of intertidal wetlands. The U.S. Fish and Wildlife Service documents shoreline erosion rates within the refuge system ranging from 9 to over 50 feet per year (USFWS 2008); this shoreline retreat results in significant reductions in ecosystem services provided by the refuge as habitats are lost or converted.

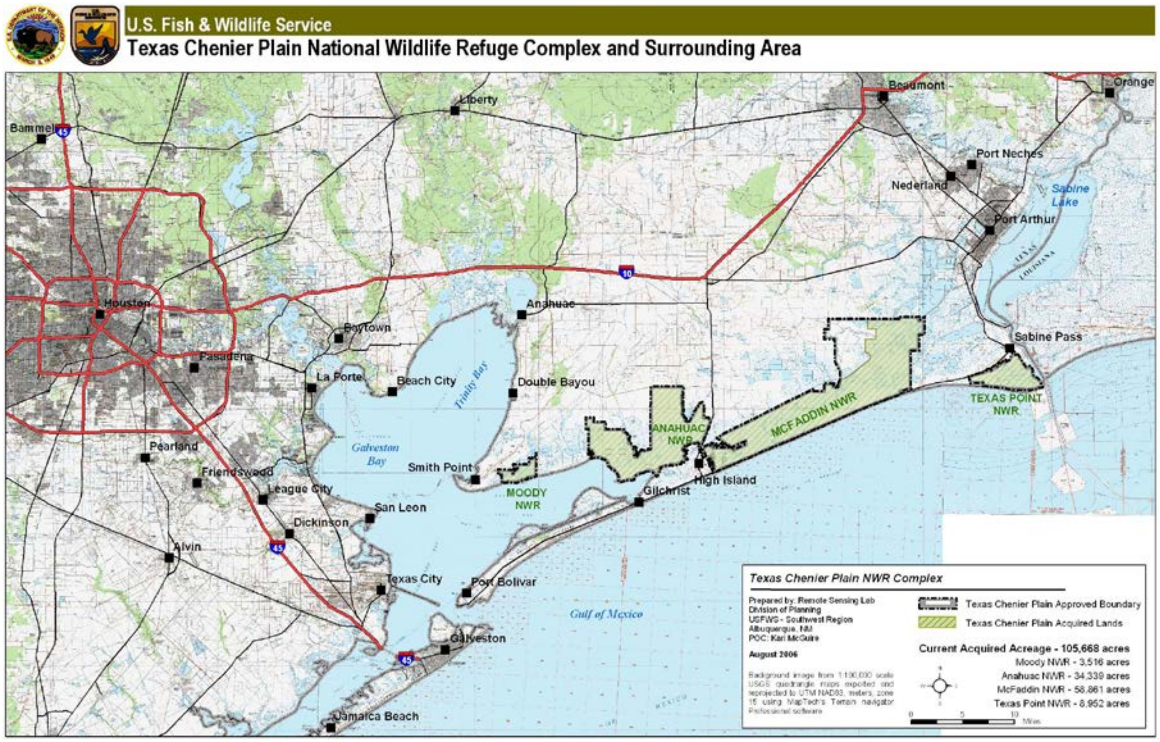


Figure 9. Location of the TCPNWRC in the context of the Galveston Bay estuary.

Independent of NOAA's current proposed project, the Refuge Management Plan identifies 47,100 linear feet of proposed offshore breakwaters that have been divided into prioritized project areas. These are intended to reduce wave energy and promote shoreline stabilization, benefiting approximately 678 acres of saline marsh; protect over 10,000 acres of fresh, intermediate, and brackish marshes and upland prairie from additional saltwater intrusion and habitat conversion; and re-establish intertidal marsh landward of the structures by planting smooth cordgrass (*Spartina alterniflora*). Similar techniques for shoreline protection/marsh restoration have been implemented successfully at several sites within the Refuge Complex on small scales by the Galveston Bay Foundation and by Anahuac National Wildlife Refuge (ANWR) staff (see Figure 10). Suspended sediments pass over the breakwaters and settle, contributing to accretion of the intertidal zone where emergent marsh vegetation propagate. The Galveston Bay Foundation has completed the first phase of breakwater construction and marsh restoration work along the East Bay project area. In 2006 and early 2007, approximately 17,000 linear feet of offshore breakwater structures were constructed, and marsh vegetation was planted in the adjacent protected area (see Figures 10 and 12). Several shoreline protection techniques have been employed, including construction fence installation (this technique has only been used in very low-energy portions of the project area, and the fencing is ultimately removed after shoreline stabilization), rip-rap installation, and 200 linear feet of reef dome installation intended to provide both shoreline protection and oyster reef habitat. TCPNWRC staff indicates a preference for rip-rap installation, reporting greater effectiveness of this technique.

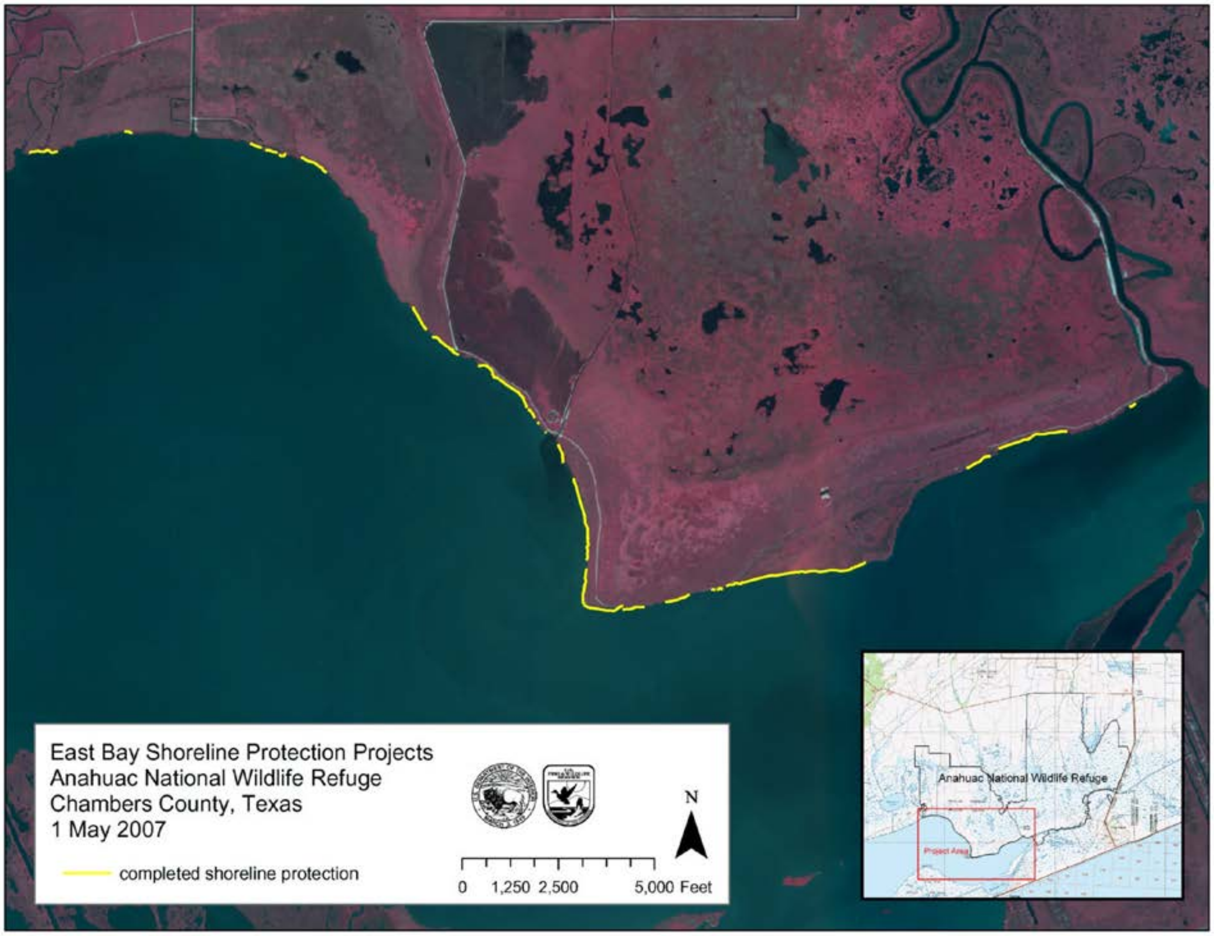


Figure 10. Shoreline protection projects completed at TCPNWRC (ANWR Unit) as of 2007.

6.1.2 RESTORATION ACTION DESCRIPTION

The proposed breakwaters will be constructed of crushed limestone or concrete rip-rap based on the stated preference of TCPNWRC staff for this technique. The design of the structures will incorporate gaps to allow for the ingress and egress of animals in the water column to the area between the breakwaters and the shoreline. The design will place the structures in depths no greater than -1 foot (NAVD 88), and will provide for relief from the bay bottom of at least 3 feet, allowing for a substantial structure that will be capable of withstanding storm events and continuing to provide shoreline protection over the 20-year breakwater design life given the anticipated effects of sea level rise throughout the region. A conceptual rendering of the proposed project design is provided in Figure 11. The shoreline protection efforts that have been implemented successfully at the site by Galveston Bay Foundation and TCPNWRC staff have typically employed less substantial, lower-relief structures (i.e., 18-24 inches in height). However, these structures are less likely to provide the level of protection required to compensate for the injury resulting from the DBL 152 Incident (1,475 DSAYs).

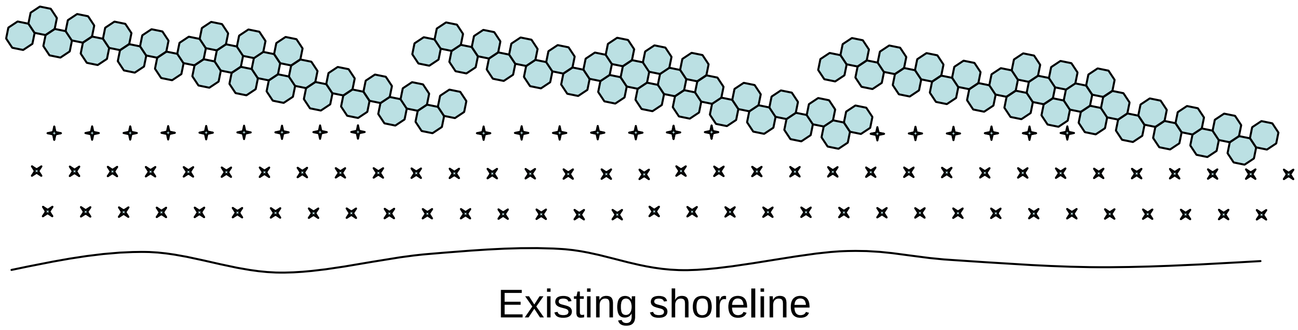


Figure 11. Conceptual rendering of the proposed project design for shoreline protection and marsh restoration at the TCPNWRC. Blue circles indicate rip-rap breakwater structure and hatch marks indicate vegetation plantings.

Figure 12. Breakwater installation undertaken in prior phases of implementation of the TCPNWRC management plan. Photo credit: Galveston Bay Foundation.

Spartina alterniflora will be planted within the protected area landward of the breakwater.

Plants will be nursery grown and will likely be multi-stemmed. Plant spacing will be determined during engineering and design of the project and may vary depending on the availability of various sizes of plants. Prior phases of project implementation have demonstrated that passive deposition of sediment that falls out of suspension in the water column on the landward side of the breakwater will serve over time to build up a shallow sloping shoreline in the project area. This will reduce erosion by dissipating wave energy, allowing waves to run up the shallow slope rather than falling directly on an exposed cut bank. Vegetation plantings will serve to accelerate this passive accretion by trapping and stabilizing sediments.

The goal of the proposed restoration action is to protect and restore a sustainable coastal herbaceous wetland that compensates the public for lost services and resources due to the Incident.

Project performance will be assessed by comparing quantitative monitoring results to predetermined performance standards that define the minimum physical or structural conditions deemed to represent normal and acceptable development of a marsh. Parameters to be assessed may include but are not limited to project elevations and slopes, percentage of vegetation cover in the project area, and the ratio of open water to emergent vegetation. The monitoring program for this project will use these standards to determine whether the project goals and objectives have been achieved, and whether corrective actions are required to meet the goals and objectives. Details concerning the performance measures and monitoring will be developed prior to implementation of the project. In the event that performance standards are not achieved or monitoring suggests unsatisfactory progress toward meeting established performance standards, corrective actions will be implemented. Possible corrective actions may include but are not limited to shoreline grading or material placement and shaping to establish a shallow sloping shoreline, fertilization of the plant community to enhance vegetative productivity, or planting vegetation in areas that experienced dieback.

6.1.3 EVALUATION OF THE ALTERNATIVE

This project meets the evaluation criteria discussed in Section 5.2. In addressing the habitat type aspect of the "nexus" criteria, NOAA determined that shoreline protection and salt marsh creation will compensate for interim losses to off-shore benthic habitat. The scaling for such restoration is accomplished through a service-to-service approach using established habitat trade-off ratios discussed above in section 3.5. Given that NOAA declined to propose off-shore benthic restoration (for reasons discussed above) and in consideration of the spatial aspect of the nexus criteria, NOAA sought a restoration action that will take place in a shoreline area near the location of the Incident. The preferred alternative also meets this criterion. This site was also preferred because of its likelihood of success, readiness for implementation and cost-effectiveness relative to the other alternatives analyzed, and its ability to provide multiple benefits (*e.g.*, services to numerous resources such as birds and wildlife, recreational opportunities, etc.). The preferred alternative rated highly in each of these categories. NOAA does not anticipate any significant risk to public health and safety as a result of implementing the preferred alternative.

Shoreline protection and salt marsh creation using the proposed breakwater construction technique is a feasible and proven technique with established methods. The technique has been used throughout coastal Texas by local, state, and federal agencies, as well as the general public, to create wetlands in an effort to address wetland loss and for mitigation. This preferred alternative, as opposed to many created marshes which have a high degree of exposure (*i.e.,* to erosive forces such as wave action), should have greater longevity due to the protective function of the wave-break. Additionally, the shoreline stabilization provides secondary benefits to roads and other infrastructure maintained by the refuge by preventing the erosive marsh edge from reaching these inland amenities. The success of previously completed and ongoing work within ANWR on similar shoreline protection projects, particularly given the accretion observed landward of constructed breakwaters resulting from those projects, provides a high level of confidence that the project is likely to succeed. Refuge staff has stated an interest in working cooperatively with NOAA to implement and monitor the preferred alternative, and their daily engagement in this project and others like it brings substantial additional technical experience.

Prior shoreline protection efforts within TCPNWRC have been focused on the ANWR Unit of the complex, and the permitting and state-owned submerged land leasing work that has been done for those projects will require amendment to incorporate the shoreline of other refuge units in the complex. This will require surveying by a licensed state land surveyor in order to obtain a lease of state-owned submerged land from the Texas General Land Office (TGLO) for project construction. The permitting process will also evaluate significant design considerations, including breakwater gaps for estuarine organism ingress and egress, daybeacon installation, total volume of material placed in jurisdictional waters, and the design specifications of material in its final configuration. The cost-effectiveness of this project will benefit from the ability to leverage ongoing construction and biological monitoring efforts for other phases of work at the site. In addition, the multiple benefits derived from this type of project (productivity of the protected marsh, productivity of the created marsh, and productivity derived from use of the rip-rap structure as habitat) result in very cost-effective achievement of the compensatory requirements for the DBL 152 Incident. The preferred restoration alternative presented in this Draft DARP/EA complies with the key statutes, regulations, and policies listed in Chapter 7.

6.1.4 ENVIRONMENTAL CONSEQUENCES

NOAA analyzed the potential effects of the preferred project on the quality of the human environment to comply with the requirements of the NEPA. The NEPA's implementing regulations direct federal agencies to evaluate the potential significance of preferred actions by considering both context and intensity. For the preferred action identified in this Draft DARP/EA, the appropriate context for considering potential significance of the action is local, as opposed to national or worldwide. With respect to evaluating the intensity of the impacts of the preferred action, the NEPA regulations (40 CFR 1508.27) suggest consideration of ten factors:

- Likely impacts of the preferred project;
- Likely effects of the projects on public health and safety;
- Unique characteristics of the geographic area in which the projects are to be implemented;
- Controversial aspects of the project or its likely effects on the human environment;
- Degree to which possible effects of implementing the project are highly uncertain or involve unknown risks;

- Precedential effect of the project on future actions that may significantly affect the human environment;
- Possible significance of cumulative impacts from implementing this and other similar projects;
- Effects of the project on National Historic Places, or likely impacts to significant cultural, scientific, or historic resources;
- Degree to which the project may adversely affect endangered or threatened species or their critical habitat; and
- Likely violations of environmental protection laws.

Likely Impacts of the Preferred Alternative

This section provides an evaluation of the potential impacts of implementing the preferred alternative on the natural, built, and human environment. Federal agencies preparing an Environmental Assessment must consider the direct effects of all components of a proposed action as well as indirect and cumulative effects.

Shoreline protection and marsh restoration would generally benefit the East Galveston Bay ecosystem by providing increased nursery, foraging, and cover habitat for numerous species of nekton that utilize the marsh fringe. Increased habitat will also provide areas for birds and other wildlife species to nest, forage, and seek protection. Aesthetic and recreational benefits will be extended to humans using the area. As proposed, the preferred alternative would also benefit the freshwater marshes and upland areas, and human infrastructure (roads, etc.) landward of the project site by extending the protective value of the bay shoreline for these resources into the future.

In general, the activities associated with the construction of breakwaters and salt marsh restoration will affect noise levels and the pursuit of recreational activities in the vicinity of the project area. However, these effects will be minor and short-term and are not expected to influence long-term use of the area by the public. Beyond these minor, short-term effects, the proposed action is expected to foster and enhance the ecological value and continued public use of the TCPNWRC. Increases in productivity should improve species abundance and diversity at the site and enhance public use of the area, especially for environmental education, recreational fishing and bird watching. The implementation of this project should not affect the local economy or its citizens; therefore, no socio-economic effects are expected.

Effects on Public Health and Safety

NOAA evaluated the potential for the preferred project to impact public health and safety by considering the following: air and noise pollution, water use and quality, geological resources, soils, topography, environmental justice, energy resources, recreation, traffic, and contaminants.

- *Air Quality*: Non-significant, temporary adverse impacts would result from the proposed construction activities. Exhaust emissions with airborne pollutants from construction equipment should be quickly dissipated by prevailing winds and would be limited to the construction phase of the project. There would be no significant, long-term adverse impacts to air quality, and the carbon sequestration service provided by the restored marsh should provide air quality benefits over the long term.

- *Noise*: Non-significant, short-term adverse impacts, limited to the construction phase, will include increased noise associated with construction equipment. There would be no long term adverse impacts.
- *Water quality*: NOAA does not anticipate any significant water quality impacts. Breakwater construction and potential marsh edge shaping could temporarily increase turbidity in water during the period of construction. After construction is completed, however, the sediments in the construction area will be less likely to remain in suspension due to the reduced energy regime in the water column landward of the breakwater, and planted vegetation should aid in the retention of sediments within the marsh complex as well as trap sediments that pass over the marsh during high water events; thereby, improving local water quality over the long term.
- *Geology*: Geology of the area would not be affected by the preferred project.
- *Environmental Justice*: The preferred project will not adversely affect the health or environment of the human population regardless of race or economic status.
- *Energy*: Without the project, erosion could expose pipelines and flowlines near the project area to increased tidal action. This project should help maintain marsh in the area for a longer period; thereby, providing some protection to adjacent buried pipelines in oil and gas fields near the project area. There would be no significant adverse impacts to infrastructure.
- *Recreation*: No significant adverse impacts to recreation are anticipated. Some temporary, minor adverse short-term impacts to recreation would occur (i.e., increased turbidity of surface water) as a result of breakwater construction activity. However, these impacts are not expected to be significant, and the long term impact of additional wetlands will be beneficial. These long term impacts would provide enhanced recreation opportunities for visitors to the TCPNWRC, including sport fishers and hunters.
- *Traffic*: There will be no short- or long-term adverse impacts to traffic in the area due to construction activities or the project. East Galveston Bay itself is large and boats can easily maneuver in around the construction zone. Additionally, there are many access routes to the various units of the TCPNWRC; therefore, all areas can be accessed during construction and following demobilization of equipment.
- *Contaminants*: There are no known or suspected sources of contaminants in the area. Therefore, construction operations are not likely to release contaminants into the human environment.

Unique Characteristics of the Geographic Area

The chenier plain of southwestern Louisiana and the upper Texas coast are subject to some of the highest rates of relative sea-level rise in North America (approximately 6.8mm/year on average in the Galveston Bay system) as a result of the combination of regional subsidence and global eustatic sea-level rise. Significant shoreline and estuarine habitat losses have resulted from this process and from associated erosion over the last century. If the preferred project functions as intended and anticipated, adjacent wetlands will experience increased sedimentation. Impacts of this nature are expected to be beneficial since sedimentation in the wetlands will provide nutrients important for plant growth and for maintenance of elevation. NOAA considers that the highly productive coastal ecosystems of the region will be enhanced by the project, and that the project will support the unique and significant cultural and economic characteristics of this region.

Potential for Controversial Aspects of the Project or its Effects

NOAA does not expect the preferred project to have any potential for public controversy.

Potential for Uncertain Effects or Unknown Risks

NOAA does not believe there are uncertain effects or unknown risks to the human environment associated with implementing the preferred project. Nevertheless, the project implementation team will conduct a thorough site survey and engineering analysis, which will address any uncertainties before implementing the preferred alternative.

Precedential Effects of Implementing the Project

NOAA has pursued wetland restoration projects to compensate for other natural resource damages claims in Texas. Wetland protection, restoration, and creation projects are regularly implemented along the Texas coast to address erosion, subsidence, sea level rise, and compensatory or mitigation requirements. The preferred project, therefore, sets no precedents for future actions of a type that would significantly affect the quality of the human environment.

Potential for Impacts to National Historic Sites or Nationally Significant Cultural, Scientific or Historic Resources

Following a review of the Texas Historic Site Atlas, NOAA determined that no recorded sites or Traditional Cultural Properties exist in the vicinity of the preferred project. Known middens exist on the East Bay shoreline near Smith Point, to the west of the proposed project, and the instability of the existing shoreline is causing these cultural resources to be lost to erosion over time. The proposed work will not disturb any known midden site, and if cultural or historic resources are encountered during construction, the project implementation team will cease activity until appropriate consultation can be undertaken with the Texas State Historic Preservation Officer (TXSHPO).

Potential for Impacts to Endangered or Threatened Species

NOAA believes implementation of the preferred restoration action identified in this Draft DARP/EA will have no adverse impact on any species listed as threatened or endangered, or habitats critical to such species, under the ESA. NOAA will confer with the USFWS and NOAA's National Marine Fisheries Service (NMFS) concurrent with public review of this Draft DARP/EA to ensure that the preferred restoration action will be compliant with the ESA. Based on correspondence with those entities, the project implementation team anticipates concurrence that the preferred project will have no adverse effect on any listed species. Should it be determined that any component of the project would adversely affect a threatened or endangered species, the project implementation team would work to identify and implement appropriate safeguards for the protection of the special status species. If no safeguards could be identified, NOAA would consider redesigning the project or substituting another project as necessary to protect threatened or endangered species.

As noted in this Draft DARP/EA, several federal and state-listed species, including the brown pelican, the piping plover, and five species of sea turtle, may occur in the areas impacted by the Incident. They may also occur in areas where NOAA is considering implementation of the proposed restoration action. Some listed species, such as the brown pelican, piping plover, and several species of sea turtle, would benefit from the restoration project.

Potential for Impacts to Essential Fish Habitat

During the construction phase of the shoreline protection and marsh restoration project, some minor, short-term and localized impacts will occur in Essential Fish Habitat (EFH). As a result of construction activities, there will be localized increases in turbidity and sedimentation near the project area. Mobile fish and invertebrates would probably not be affected, since these would most likely leave the area, and return after project completion. Increased noise levels due to the operation of heavy equipment would also cause mobile fish to leave the area until operations (the source of the noise) end. Ultimately, EFH would benefit from the stabilization, re-establishment, and creation of marsh achieved through implementation of the preferred restoration action. Salt marsh serves as habitat for prey of some managed fish species and provides nursery habitat for the larval and juvenile stages of many managed species. An EFH consultation will be initiated with the NMFS during the public review and comment period for this Draft DARP/EA. A consultation letter will be sent to NMFS Habitat Conservation Division personnel requesting concurrence with the determination of this Draft DARP/EA that the potential impacts of the project on EFH and marine fishery resources are adequately described in the document and that the preferred restoration action will not have a net adverse effect on EFH.

Potential for Violation of Environmental Protection Laws

The proposed project would be implemented in such a way as to comply with all applicable environmental protection laws.

Conclusion of the NEPA Analysis and Finding of No Significant Impact

Under 40 CFR 1501.5 and 1501.6, for the purposes of this NEPA analysis, NOAA is the lead agency. Based on the analysis of the available information presented in this document, NOAA does not anticipate that implementation of the shoreline protection and salt marsh restoration project on the north shoreline of East Galveston Bay in the Texas Chenier Plain National Wildlife Refuge Complex, identified as preferred herein, will significantly impact the quality of the human environment. All potential beneficial and adverse impacts have been considered in reaching this conclusion. If any information indicating the potential for significant impacts is revealed through the public review and comment process on this Draft DARP/EA, NOAA may substitute an alternative action. If an alternative action becomes necessary, NOAA may select one of the projects described below that were evaluated but not preferred or consider a new project or projects (subject to an Environmental Assessment). Issuance of a Finding of No Significant Impact (FONSI) based upon an Environmental Assessment would fulfill and conclude all requirements for compliance with NEPA by NOAA.

6.1.5 SCALING OF THE PREFERRED ALTERNATIVE

As explained in Section 3.5, HEA is a model that is used to calculate "debits" (estimating habitat injuries or other resource service losses) due to adverse effects resulting from exposure to oil, and to balance these "debits" against the ecological service "credits" to be gained as compensation from the preferred habitat restoration action. The scale, or size, of a restoration project should be such that it provides enough ecological service gains to offset the total of the losses. To quantify ecological benefits, HEA uses several project-specific factors in scaling restoration, including elapsed time from the onset of injury to restoration implementation, relative productivity of restored habitats (that is, how the services previously provided by the injured habitat compare to the services provided by the restored habitat), time required for restored habitats to reach full function, and project lifespan. A HEA was used by NOAA to determine whether the preferred project would be adequate to compensate for the losses described in Chapter 3.

To identify an appropriate "relative productivity" input parameter for the shoreline protection and marsh restoration components, NOAA relied on information found in the scientific literature regarding the levels of functional equivalency in rip-rap structure and herbaceous marshes throughout a project's life for primary productivity, soil development, nutrient cycling, food chain support, benthic biomass production, and fish and shellfish production (Peterson *et* al. 2007; Craft *et al.* 1999; Minello 1999; Minello and Webb 1997; Currin *et al.* 1995; Levin *et al.* 1996; Scatolini and Zedler 1996; Thompson *et al.* 1995; Peck *et al.* 1994; Langis *et al.* 1991; LaSalle *et al.* 1991; Moy and Levin 1991; Broome 1990; Broome *et al.* 1986; Seneca *et al.* 1985; Lindau and Hossner 1981; Parker *et al.* 1980; Cammen 1976).

As described in Section 3.5, NOAA determined the relative productivity of injured and restored habitats based on a literature review and settled case history (Table 6). NOAA considered that differences between published values for inshore and offshore benthic productivity, or between values published in various studies of offshore benthic habitat, may be explained by variation in sampling seasonality or location, production/biomass ratios, and by variable methodologies with regard to inclusion or exclusion of taxonomic groups and weight classes. NOAA's use of a 4.5:1 ratio for converting mud bottom injury to marsh restoration as suggested by Peterson et al. 2007 approximates the central tendency among published literature values and is similar to the 5:1 ratio employed by the TX Trustees in settled case history relative to inshore benthic habitats.

NOAA also estimated the constructed breakwater would likely yield 95% of the services of a typical rip-rap structure in 3 years, remain at that level of service for five years, and provide 20 years of total service. Converting the per acre EqDSAY values for rip rap productivity discussed in section 3.5 to per mile values leads to an estimate of approximately 7.1 EqDSAYs per mile of rip rap constructed.

NOAA estimated that the restored marsh component would likely yield 71.3% of the services of a fully functioning marsh in 15 years, would plateau at that level of services, then degrade linearly over 8 years once the shoreline protection benefits of the rip rap structure ceased, with no services from the restored marsh by the end of the 8-year period. To scale this element of the project, NOAA converted the per acre EqDSAY values discussed in section 3.5 to per mile values. Each mile of rip rap structure built (and associated marsh grass plantings) leads to an estimated 2.73 acres of marsh created, which, in turn results in an estimated 101 EqDSAYs.

In addition to the productivity services provided by the rip rap structure and the restored marsh component, NOAA estimated a shoreline protection benefit from the rip rap structure and restored marsh. This is estimated assuming prevention of erosion of 2.5 feet of marsh per year and the productivity services associated with that area of marsh. These protective services begin with the construction of the rip rap and cease once the restored marsh has eroded. NOAA estimates that each mile of rip rap structure built will protect 8.5 acres of marsh over the project's lifetime. This, in turn, will result in an estimated lifetime benefit of 240 EqDSAYs per mile of rip rap when the same 4.5:1 ratio described above is applied.

Comparing these services with the injury EqDSAYs of 1,475 indicates that 4.23 miles of rip rap as proposed by the project should compensate the public for the losses from the Incident.

Table 6. HEA input parameters and associated literature and case history support.

HEA Parameter	Value Used for Scaling	Literature/Settled Case History Support for Value
Ratio of Value of Created or Protected Marsh to Injured Offshore Benthic Habitat	1 acre salt marsh: 4.5 acres offshore benthic habitat	TX Trustees, 2001: Lavaca Bay NPL Site Final Damage Assessment & Restoration Plan/Environmental Assessment. Peterson *et al.* 2007. Parker *et al.* 1980.
Ratio of Value of Created Rip-Rap Structure to Injured Offshore Benthic Habitat	1 acre rip-rap : .45 acre offshore benthic habitat	DE, NJ, & PA Trustees, 2009: *Athos I* Oil Spill Final Restoration Plan & Environmental Assessment.

6.2 SUMMARY OF NON-PREFERRED ALTERNATIVES

NOAA considered a number of restoration alternatives (Section 5.4) to compensate for ecological losses resulting from the Incident. Projects considered further, but not preferred for implementation, are listed in this section. While many of these non-preferred restoration alternatives were expected to be beneficial, NOAA ultimately concluded that either the alternatives did not meet one or more of the evaluation criteria discussed in Section 5.2, or better alternatives existed. If problems with the preferred restoration project are brought forward during the public review and comment period or are identified during planning of the preferred project (including engineering and design, permitting, and bid solicitation), NOAA may reconsider one of the non-preferred alternatives meeting the evaluation criteria in Section 5.2. The approximate locations of alternatives considered, but not preferred, are shown in Figure 8 (Section 5.4, above), and brief descriptions and evaluations of each non-preferred alternative are provided below.

Capping contaminated sediments beneath offshore production platforms

Project Description

This project involves the capping of contaminated sediments (soft mud bottoms) at the bases of inactive offshore oil and gas production platforms in the vicinity of the Flower Garden Banks National Marine Sanctuary (refer to Figure 8), and is located approximately 140 km from the location of the Incident.

Platforms in the vicinity of the Sanctuary are required to shunt used, contaminated drilling fluids ("mud") for disposal near the sea floor. Releasing them into the upper water column is prohibited because they might drift over the coral colonies within the Sanctuary. Because of this practice, locally concentrated areas of contaminated sediments result beneath these platforms, and the potential exists for these contaminants to be taken up and stored in the tissues of benthic invertebrates, and to bio-accumulate at higher trophic levels. Under this project, platforms with known, elevated concentrations of contaminants would be identified, and the "mud" would be capped using uncontaminated dredged material obtained elsewhere in the Gulf of Mexico.

Evaluation of the Alternative

This alternative is the only in-kind compensatory restoration proposed for the DBL 152 Incident (i.e., the only one seeking to restore off-shore benthic habitat of the type injured by the spill), yet it is also likely the most technically challenging. For instance, identifying, gathering, and transporting appropriate material for use in the capping operation (which could require up to approximately 1.5 million cubic yards of material) would be difficult. NOAA considered that identifying a technique for placing material at depth in a manner that would confine the placement to impacted areas, and limit the potential for sedimentation impacts to adjacent hard-bottom resources within the Sanctuary, would likely prove excessively time-consuming and costly.

No known dredging operations of the type and at the depths proposed have been undertaken in the Gulf of Mexico. NOAA considered dredging costs typical of frequently implemented inshore/estuarine dredging operations using cutter-head dredges as a starting point for evaluating costs, though the proposed offshore operations would require more costly hopper dredges, and the required placement technique (shunting sediments to the seafloor at depths of roughly 100m) is not known to have been implemented anywhere. Using an average (inshore, cutter head) cost for material dredging and placement of $8/cubic yard, the costs of dredging and placing 1.5 million cubic yards of material alone would be $12 million. This is a low estimate of construction costs, is roughly twice the total estimated cost of the preferred alternative, and does not account for more complicated planning, monitoring, and administration and oversight required of this alternative. Total costs of the proposed alternative could very easily rise above

$50 million given the dredging and placement requirements and increased complexity in planning, monitoring, and managing the project.

Given its novelty, baseline and post-implementation monitoring to determine actual benefits derived from the project, and permitting, this type of activity would prove problematic. Though this alternative is in-kind restoration, scaling could be difficult because of a lack of information about the extent of contamination. While the extent of these areas of contaminated sediments is unclear, it is unlikely that more than 0.25 acres is impacted beneath any single platform. Additionally, only a few of the platforms in the Gulf of Mexico present restoration opportunities by virtue of proximity to the Sanctuary and the presence of drilling fluid shunting operations that might lead to concentrating contaminated sediments. This type of project would be infeasible for the reasons identified above and because shunting used drilling mud to the sea floor is not required outside the immediate vicinity of the Sanctuary. Rather, in other locations the mud can be released into the water column, where it tends to disperse so that concentrations of contaminants in sediments below the platforms are not a concern.

Pierce Marsh Restoration

Project Description

Pierce Marsh is a subsided intertidal and high salt marsh complex adjacent to Highland Bayou in Hitchcock, Texas, on the north side of West Galveston Bay at approximately 94.97^{O}W by 29.31^{O}N. Upland areas in the vicinity are owned and managed for conservation purposes by the Galveston Bay Foundation, but ownership of tidally influenced areas within the system is claimed by the state of Texas, and management responsibility for these areas falls to the Texas General Land Office. Since the late 1990s, several distinct marsh restoration activities, including marsh terracing and dredged material beneficial use, have improved over 400 acres at the site. There is additional capacity within existing dredged material containment levees, constructed for a recently implemented beneficial use project, which affords an opportunity to restore up to 150 acres of additional intertidal marsh. Approximately 25% of the area within the existing containment cells has been brought to intertidal elevation by prior dredged material placement activities. Therefore, there is still adequate capacity to create marsh within the existing containment cells while maintaining significant marsh edge interface with shallow open water.

Evaluation of the Alternative

As this project is located in West Galveston Bay, the geographic nexus to the injury location is weaker than that for alternatives that, like the preferred alternative, are in East Galveston Bay or the Sabine Lake area. Given the success of the habitat restoration activities previously undertaken at the site, additional work would be supported by adjacent landowners and would not likely encounter any significant obstacles in terms of permitting. Based on costs of similar, recently completed projects in West Galveston Bay, NOAA estimates the total cost of this proposed alternative would be similar to or higher than that of the proposed alternative (~$5-$10 million). NOAA considered the most significant challenge to implementation would likely be the availability of adequate dredged material. Previous efforts at the site have made use of maintenance material from channels in the neighboring “Harborwalk” subdivision, but availability of additional material from this source is unknown. Also, the willingness of the current subdivision developer to participate in the project is likely reduced given that the development recently changed hands as a result of foreclosure proceedings. Additional dredged material could also be available from maintenance dredging of the adjacent Gulf Intracoastal Waterway, or from upland dredge material placement sites maintained by the U.S. Army Corps of Engineers (USACE), but coordination with the USACE to access either of these sources would likely severely impact project timing. A project at this site would benefit from synergy with biological monitoring of previous restoration activities at the site. There would be minor environmental impacts associated with dredging and then depositing the dredged material. These impacts would primarily be in the borrow and fill areas, although an increase in turbidity would affect water quality for a short period of time. This alternative would not be expected to have significant adverse socioeconomic impacts.

Snake Island Cove Submerged Aquatic Vegetation (SAV) Restoration

Project Description

Snake Island Cove is a 900-acre shallow water, marsh-lined cove located in West Galveston Bay, just east of the community of Sea Isle, at approximately 95.04^{O}W by 29.16^{O}N. As the site is submerged, it is owned by the state of Texas and managed by the Texas General Land Office. Estuarine habitats located within Snake Island Cove include estuarine shallow water habitat, emergent wetlands, remnant seagrass beds, and tidal flats.

Historically, the offshore oyster reefs of West Bay provided two functions benefiting seagrass beds: they reduced turbidity through filtration; and they provided structure that acted as a natural wave-break, reducing fetch across the bay. The geomorphology of the site (a peninsular shoal extending from Galveston Island westward beyond Snake Island) created a sheltered, shallow estuarine cove vegetated with extensive seagrass beds and surrounded by unfragmented tracts of estuarine wetlands and coastal prairie. The construction of the Texas City Dike in the 1940s significantly altered circulation patterns in West Bay, reducing freshwater inflows to the point that the majority of the oyster reefs died. The oysters were unable to reproduce due to the increased salinity, and they were less resistant to the oyster parasite *Perkinsus marinus* (“dermo”). Concurrently, massive oyster shell dredging projects were conducted for use in construction. West Bay has also suffered from increased turbidity from dredging for channelized subdivisions on the west end of Galveston Island. These problems combined with subsidence (caused by the withdrawal of groundwater from shallow geologic formations) and erosion (caused by increased exposure of the fringing marsh to fetch and resulting in even further increased turbidity and sedimentation) to effect a 100% loss of seagrass beds from the site between 1950 and 1990.

Based on a review of historic aerial photography using GIS, NOAA staff estimates that over 200 acres of seagrasses were present in the sheltered waters of Snake Island Cove in 1956. Anecdotal information suggests that these SAV beds were dominated by turtlegrass (*Thalassia testudinum*). In 2007, only small, scattered patches of widgeongrass (*Ruppia maritima*) and shoalgrass (*Halodule wrightii*) were present at the site, primarily interspersed between remaining fragmented marsh. The shape of Snake Island itself had also been significantly altered by effects of subsidence and the increased exposure to fetch, to the detriment of colonial waterbirds that use the site for loafing and nesting. In the 1940s and 1950s, Snake Island was considered an important enough site for colonial waterbird nesting that the Audubon Society leased the site from the Texas General Land Office for the purpose of conserving the habitat. However, as a result of wind and wave action, the island has physically shifted to such an extent that it no longer falls within the boundaries of this leased area.

Galveston Bay Foundation acquired funding to restore habitats at the site, contracted with an engineering firm to develop construction specifications, and began construction at the site in August 2007 to create up to 100 acres of protected shallow water habitat to allow for the re-establishment of historically present seagrass beds behind newly installed breakwaters. The breakwaters were to be built in offshore areas (e.g., up to 1.5 miles from the shoreline) on a submerged shallow shoal with a primary goal of reducing turbidity in areas shoreward of the breakwaters. As of 2012, the installation of approximately 4,900 linear feet of geo-textile tube breakwaters has been completed, providing erosion protection for approximately 230 acres of existing salt marsh wetlands, and reducing wind and wave energy and associated turbidity in approximately 85 acres of the cove, allowing for SAV re-establishment in that area. Design specifications have been developed for the installation of another 1,000 linear feet of geo-textile tube breakwater, which could reduce wind and wave energy in another 30 acres of open water area in the cove, allowing for passive SAV re-establishment in that area, and protecting another 50 acres of existing salt marsh.

Evaluation of the Alternative

As this project location is in West Galveston Bay, the geographic nexus to the injury location is considerably weaker than that for the preferred and other alternatives in East Galveston Bay or the Sabine Lake area (the Snake Island Cove site is approximately 40 miles farther to the southwest than the preferred alternative). The technique for executing this project is adapted from several similar projects constructed in West Galveston Bay, which incorporated wave-breaks for protection of constructed marsh against erosion and unexpectedly resulted in SAV recruitment. The effectiveness of the technique has not been quantitatively assessed, meaning that the likelihood of success is not clear. In the two instances where this technique has been implemented, one resulted as an unexpected benefit of a project designed for a different purpose (protection of constructed marsh from fetch) in which the benefits took several years to manifest, and no consistent monitoring of the results has been undertaken; the other has not been in place long enough to show results.

Leveraging compensatory restoration against ongoing community-based habitat restoration would benefit both efforts. This alternative could also benefit from existing engineering and design work and monitoring plans developed for the ongoing community-based restoration project. Though the estimated cost of this proposed project is relatively low (~$0.5-$1 million), the associated benefits are difficult to assess due to the relatively untried nature of this restoration technique. Scaling the restoration benefits of the project would require NOAA to derive HEA parameters based on very limited past precedent and inadequate literature data. Also, with the work already conducted on this effort by the Galveston Bay Foundation, it is doubtful that enough potential restoration remains to compensate for the DBL 152 injuries.

There would be minor environmental impacts associated with construction of the geo-textile wave-break, including the dredging required to fill the geo-textile tubes. These impacts would primarily be limited to the construction areas, and an increase in turbidity would affect adjacent water quality for a short period of time. This alternative would not be expected to have significant adverse socioeconomic impacts.

Delehide Cove/Starvation Cove Marsh Restoration

Project Description

Texas Parks and Wildlife Department led the construction of two salt marsh restoration projects at Delehide Cove and Starvation Cove between 2003 and 2006. These projects are located in West Galveston Bay adjacent to the communities of Pirate's Beach and Lafitte's Cove, on submerged land owned by the state of Texas and managed by the Texas General Land Office. The sites were subjected to severe subsidence and erosion beginning in the 1950s .

The Delehide Cove Marsh Restoration Project, located at approximately 94.94^{O}W by 29.23^{O}N, resulted in protection of approximately 250 acres of existing salt marsh against erosion and restoration of 48 acres of salt marsh. The Starvation Cove Marsh Restoration Project, located at approximately 94.94^{O}W by 29.24^{O}N, resulted in protection of approximately 10 acres of restored marsh, 180 acres of existing estuarine emergent marsh, 0.2 acres of palustrine emergent marsh, 144 acres of tidal flats and 100 acres of upland prairie. Both projects employed a technique which involved borrowing material from bay bottom at depths greater than 5 feet to create intertidal habitat mounds behind a permanent geo-textile tube wave barrier. As of 2008, construction was completed to establish 800 linear feet of geo-textile tube wave barrier in the "gap" between the tubes installed for the two projects.

The alternative considered by NOAA for restoration at this site would create additional marsh acreage between the two previously constructed projects and on the eastern end of the Starvation Cove project. An additional five acres of intertidal marsh could also be constructed behind the new wave-break installed in the gap between the two projects. At the eastern end of the Starvation Cove project, a maximum of 40 additional acres of salt marsh could be built, and additional wave barrier installation would be required to protect any new marsh constructed at that site.

Evaluation of the Alternative

As this project location is in West Galveston Bay, the geographic nexus to the injury location is weaker than that for alternatives that, like the preferred alternative, are in East Galveston Bay or the Sabine Lake area. This project is not as well developed conceptually as the preferred alternative, and tasks required to achieve the same level of project readiness (permitting, etc.) are substantial. The availability of project partners to support implementation and monitoring in technical capacities, and the availability of engineering and design, construction, or planting contractors are likely limited by significantly larger-scale projects currently being constructed in the vicinity. At the same time, additional construction at this site could benefit from synergy with previously constructed, ongoing, and proposed projects on the west end of Galveston Island. Biological monitoring efforts are ongoing and could be expanded to include new project sites. The likelihood of success for new salt marsh creation is high, given the success of previously constructed projects in the area, and the project would be easily scalable under the HEA using past precedents. There would be minor environmental impacts associated with dredging and then depositing the dredged material. These impacts would primarily be in the borrow and fill areas, although an increase in turbidity would affect water quality for a short period of time. This alternative would not be expected to have significant adverse socioeconomic impacts.

Bessie Heights Marsh Restoration

Project Description

Approximately 200 acres of restored salt marsh have been constructed by the Texas Parks and Wildlife Department (TPWD) at Bessie Heights, a subsided salt marsh, high marsh, and coastal prairie complex located on the J. D. Murphree Wildlife Management Area at approximately 93.95^{O}W by 30.04^{O}N. This included approximately 95 acres of marsh terracing and approximately 105 acres of beneficial dredged material placement, confined by training levees and the terrace field. Additional salt marsh acreage could be constructed at the site, in units ranging in size from 65 acres to over 400 acres. Site managers indicate that this additional acreage should be constructed using dredged material rather than through additional terracing. The previous beneficial use project made use of dredged material from the Sabine-Neches Waterway, and additional suitable dredged material is available from the same source.

Evaluation of the Alternative

Beneficial use of material from the Sabine-Neches Waterway would require significant effort to coordinate between the USACE, the Jefferson County Navigation District (JCND), and TPWD. Both the USACE and the JCND would likely favor its use. A proposal for deepening and widening the Sabine-Neches Waterway was completed by the USACE and forwarded to Congress; however, Congress has not yet authorized the project, and the timing of any action remains unclear. Thus, it is likely that coordinating project timing with USACE dredging cycles would present challenges. Proximity to existing restoration efforts, ongoing biological monitoring, and minimal site preparation requirements (i.e., extant training levees requiring minimal maintenance for use) contribute to the likelihood that a project implemented at this site would succeed. Availability of dredge equipment, distance required for pumping material (and associated cost), and permit coordination present challenges to project implementation at the site. A project implemented at this site would be easily scalable under the HEA using past precedents, though restoration unit sizes pre-determined by TPWD may limit options for project implementation size. There would be minor environmental impacts associated with dredging and then depositing the dredged material. These impacts would primarily be in the borrow and fill areas, although an increase in turbidity would affect water quality for a short period of time. This alternative would not be expected to have significant adverse socioeconomic impacts.

Old River Cove Shoreline Protection and Habitat Restoration

Project Description

Old River Cove is a tertiary embayment located at the north end of Sabine Lake near Port Arthur, TX at approximately 93.84^{O}W by 29.98^{O}N. The south-facing shoreline of this embayment is exposed to over 10 miles of open water fetch across Sabine Lake. This shoreline experiences a predominant south-easterly wind regime and consistent ship traffic through the Gulf Intra-coastal Waterway and the Sabine-Neches Waterway, which generates erosive wave energy that has resulted in significant shoreline retreat. A project at this site would involve construction of a linear shoreline protection feature such as an offshore wave-break, construction of an intertidal marsh platform behind this structure by either filling or grading the existing shoreline to create a gently sloping shoreline, and planting native salt marsh vegetation in this intertidal zone. As much as two linear miles of shoreline could benefit from such protection; the marsh creation component of the project could potentially result in up to 7.5 acres of restored marsh habitat, and the project could protect up to 300 acres of existing salt marsh habitat. The project would be built in submerged land owned by the state of Texas and managed by the Texas General Land Office, and adjacent land is privately held.

Evaluation of the Alternative

The Old River Cove project site is adjacent to a marsh restoration project constructed as mitigation for impacts resulting from the construction of a liquid natural gas (LNG) facility on the Sabine-Neches Waterway. Texas Parks and Wildlife Department staff with the J. D. Murphree Wildlife Management Area provided oversight for that project, and they support the concept of additional shoreline protection for the marsh complex at Old River Cove. The shoreline protection and marsh creation project would benefit from proximity to the recently constructed mitigation project. The size of the project to be constructed can easily be scaled, and efficiencies could be realized by using biological monitoring protocols for the site compatible with those undertaken to ensure compliance with mitigation requirements at the adjacent site. Availability of materials, equipment, and equipment operators could present the most significant challenges to implementing this project, due to its small scale and the significant ongoing demands on construction contractors throughout the region resulting from the impacts of hurricanes in 2005 and 2009. The project does not demonstrate the same level of readiness as the preferred alternative, as no permitting or conceptual design work has been completed for the site. The project is easily scalable under the HEA using past precedents. There would be minor environmental impacts associated with construction of the shoreline protection structure and marsh creation. These impacts would primarily be limited to the construction areas, and an increase in turbidity would affect adjacent water quality for a short period of time. This alternative would not be expected to have significant adverse socioeconomic impacts.

Evaluation of the "No Action/Natural Recovery" Alternative

The NEPA requires NOAA to consider a "no action" alternative, and the OPA regulations require consideration of the natural recovery option. These options are equivalent. Under this alternative, NOAA would take no direct action to restore injured natural resources. Instead, NOAA 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. This approach relies on the capacity of ecosystems to "self-heal" and, in this case, is preferred as the primary restoration alternative.

While natural recovery of the injured natural resources has likely occurred over time, compensation for significant interim losses would not be provided under the no action/natural recovery alternative. The OPA regulations, however, clearly establish NOAA's authority to seek compensation for interim losses pending recovery of the natural resources. Losses were suffered during the period of recovery from this Incident and technically feasible, cost-effective alternatives exist to compensate for these losses. Therefore, the no action/natural recovery option is not preferred as a compensatory restoration alternative.

6.3 CUMULATIVE IMPACTS

NOAA examined a variety of alternatives to restore resources and/or services lost as a result of the DBL 152 oil spill. Anticipated environmental consequences arising from the preferred alternative are provided in section 6.1. As required by NEPA, this section addresses the potential overall cumulative impacts of implementing this restoration plan.

Cumulative impacts are impacts that result from an action along with other past, present, and reasonably foreseeable near-term future actions taken together. Significant cumulative impacts can result from a combination of actions that do not have significant impacts individually. Taken collectively, the effects of several actions may be additive, countervailing, or synergistic. Impacts are considered regardless of the agencies or parties involved. Thus, in considering cumulative impacts, this analysis is not limited to the actions of this case but also considers other projects in the region.

Overall, NOAA's preferred restoration project for the DBL 152 NRDA will result in a long-term net improvement in fish and wildlife habitat, restoration of ecological balance in areas where disturbances have led to adverse impacts on sensitive native species, and improvement in the natural resource services provided by fish and wildlife in the region. Cumulative impact analysis is nonetheless performed to evaluate whether there are specific components of the preferred action that, when considered in combination with other closely related past, present, and future actions in the affected area, have potentially significant cumulative adverse effects.

NOAA evaluated the preferred restoration project in this Draft DARP/EA in conjunction with other known past, proposed or foreseeable closely related projects that could potentially add to or interact with this project within the affected area to determine whether significant cumulative impacts may occur. The preferred project is part of ongoing land management, habitat restoration, and environmental protection efforts described in the Management Plan for the Texas Chenier Plain National Wildlife Refuge Complex (Refuge Management Plan), which has already undergone complete NEPA review and approval by the USFWS. Therefore, NOAA considered the cumulative effects of the preferred action and other management actions that will potentially be taken by the USFWS pursuant to the Refuge Management Plan. Similarly, many of the nearshore non-preferred projects in this Draft DARP/EA may be undertaken in the future by other entities.

Cumulatively, natural resource improvement projects in the Refuge Management Plan, the non-preferred projects described in this Draft DARP/EA, and other similar projects that may be undertaken in the Galveston Bay area are expected to result in similar environmental effects (beneficial and adverse) as the preferred project in this Draft DARP/EA. In the long-term, the overall water quality effects of the selected habitat improvement project and other past and reasonably foreseeable restoration projects are expected to be beneficial, since they are generally acknowledged to provide favorable water quality improvements and enhanced biological activity. Construction for some of the projects could cause temporary water quality impacts; however, these impacts would be limited in scope and duration, would be mitigated by use of best management practices, and are unlikely to contribute to cumulatively significant water quality impacts in Galveston Bay. In addition, habitat creation or improvement projects, whether marsh creation, submerged aquatic vegetation (e.g., Snake Island Cove), or others, would have the cumulative effect of enhancing the habitat available to marine species for spawning, feeding, etc., within Galveston Bay.

For further detailed discussion of cumulative impacts, the reader is directed to the Refuge Management plan (USFWS 2008).

In addition, NOAA considered whether there is the potential for cumulative impacts with restoration projects that may be undertaken as a result of the Deepwater Horizon oil spill. However, conducting such an analysis is problematic. As of the time this document was drafted, restoration related to Deepwater Horizon was still in the planning phases. Certain potential early restoration projects have been identified; however, none of those are anticipated to occur in the Galveston Bay area. Ultimately, the restoration planning process for that case may yield restoration projects near the preferred project in this Draft DARP/EA; however, the nature and details of such projects is sufficiently uncertain as to make a cumulative impacts analysis at this time infeasible.

CHAPTER 7 COMPLIANCE WITH ENVIRONMENTAL LAWS, REGULATIONS, AND POLICIES

7.1 THE OIL POLLUTION ACT

The Oil Pollution Act, 33 USC § 2701 *et seq*. (OPA), establishes a liability regime for oil spills that injure or are likely to injure natural resources and/or the services that those resources provide to the ecosystem or humans. Pursuant to OPA, federal and state agencies and Indian tribes act as Trustees on behalf of the public to assess the injuries, scale restoration to compensate for those injuries, and implement restoration. This Draft DARP/EA has been prepared by NOAA, the designated natural resource Trustee for natural resources injured by the Incident. OPA defines "natural resources" to include land, fish, wildlife, water sources, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any State or local government or Indian tribe, or any foreign government. Assessments are intended to provide the basis for restoring, replacing, rehabilitating, and acquiring the equivalent of injured natural resources and services. OPA authorizes Trustees to assess damages for natural resources injured under their trusteeship. OPA further instructs the designated Trustees to develop and implement a plan for the restoration, rehabilitation, replacement, or acquisition of the equivalent of the injured natural resources under their trusteeship. The regulations for natural resource damage assessments under OPA are found at 15 CFR Part 990.

7.2 THE NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA), 42 U.S.C. 4321, et seq.; 40 CFR Parts 1500-1508, sets forth a specific process of impact analysis and public review. NEPA is the basic national charter for the protection of the environment. Its purposes are to "encourage productive and enjoyable harmony between man and the environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; and to enrich the understanding of the ecological systems and natural resources important to the Nation" 42 U.S.C. §4321. NEPA provides a mandate and a framework for federal agencies to consider all reasonably foreseeable environmental effects of their proposed actions and to involve and inform the public in the decision-making process. NEPA also established the Council on Environmental Quality (CEQ) in the Executive Office of the President to formulate and recommend national policies which ensure that the programs of the federal government promote improvement of the quality of the environment.

Generally, when it is uncertain whether an action will have a significant effect, federal agencies will begin the NEPA planning process by preparing an environmental assessment (EA). The EA may undergo a public review and comment period. Federal agencies may then review the comments and make a determination. Depending on whether the effects of a preferred project are considered significant, an environmental impact statement (EIS) or a finding of no significant impact (FONSI) will be issued.

In accordance with the regulations implementing the OPA NRDA process, NOAA integrated OPA restoration planning with the NEPA process (15 CFR § 990.23). Accordingly, this Draft

DARP is integrated with a NEPA EA document. The integrated process allows NOAA to meet the public involvement requirements of OPA and NEPA concurrently. Shoreline protection projects of the type proposed in this Draft DARP/EA are also contemplated in the Management Plan for the Texas Chenier Plain National Wildlife Refuge Complex. That Management Plan has already undergone complete NEPA review and approval by the USFWS.

7.3 OTHER POTENTIALLY APPLICABLE LAWS, REGULATIONS, AND POLICIES

As described above, OPA, NEPA, and federal regulations implementing these laws are the major federal laws and regulations guiding the development of this Draft DARP/EA for restoration of injured resources and services resulting from the T/B DBL 152 oil spill. However, there are other laws, regulations or policies that may be pertinent to either the approval of this DARP/EA or to implementation of the specific restoration action proposed herein. Potentially relevant laws, regulations, and policies are set forth below.

7.3.1 FEDERAL LAWS, REGULATIONS, AND POLICIES

Clean Water Act, 33 U.S.C. 1251, et seq.

The federal Water Pollution Control Act (commonly referred to as the Clean Water Act or CWA) is the principal federal statute governing water quality. The CWA's objective is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The CWA regulates both the direct (point source) and indirect (non-point source) discharge of pollutants into the Nation's waters.

Section 402 of the CWA established the National Pollution Discharge Elimination System (NPDES) program. The CWA allows EPA to authorize state governments to implement the NPDES program. Section 301 prohibits the discharge into navigable waters of any pollutant by any person from a point source unless it is in compliance with a NPDES permit. Section 319 directs states to identify best management practices and measures to reduce non-point source pollution.

Section 311 of the CWA regulates, among other things, the discharge of oil and other hazardous substances into navigable waters, adjoining shorelines, and waters of the contiguous zone. The CWA allows the federal government to remove the substance and assess the removal costs against the responsible party. The CWA defines removal costs to include costs for the restoration or replacement of natural resources damaged or destroyed as a result of a discharge of oil or a hazardous substance.

Section 404 of the Act authorizes the U.S. Army Corps of Engineers (USACE) to issue permits, after notice and opportunity for public hearing, for the discharge of dredged or fill material into the waters of the United States. Section 401 of the CWA provides that any applicant for a federal permit or license to conduct any activity which may result in any discharge into navigable waters must obtain certification of compliance with state water quality standards.

Should the preferred project require any amendment to an existing CWA permit, NOAA and/or USFWS (as the property manager and potential project implementer) will be required to apply for the amendment to the permit prior to project implementation.

Rivers and Harbors Appropriation Act of 1899, 33 U.S.C. § 401 et seq.

The Rivers and Harbors Act regulates the development and use of the Nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the U.S. Army Corps of Engineers with authority to regulate discharges of fill and other materials into such waters.

Coastal Zone Management Act, 16 U.S.C. § 1451, et seq.

The goal of the Coastal Zone Management Act (CZMA) is to encourage and assist states to preserve, protect, develop and, where possible, restore and enhance valuable natural coastal resources. Participation by states is voluntary. Texas developed the Texas Coastal Management Program pursuant to the requirements of the federal CZMA, and the program was approved by NOAA in 1996. The enforceable policies pursuant to the CZMA are found in Chapter 33 of the Texas Natural Resources Code. The Texas Coastal Coordination Council implements the federal CZMA for the Texas coast.

Section 1456 of the CZMA requires that any federal action inside or outside of the coastal zone that affects any land or water use or natural resources of the coastal zone shall be consistent to the maximum extent practicable with the enforceable policies of approved state management programs. It states that no federal license or permit may be granted without giving the State the opportunity to concur that the project is consistent with the state's coastal policies. The regulations implementing the CZMA, 15 CFR Part 930, outline the consistency procedures.

The preferred project would occur on submerged lands owned by the State of Texas. Implementing the project in the proposed location would require a land lease between the Refuge and the State, as has been done with other similar projects in the area. This will likely require a federal consistency determination under the CZMA. Accordingly, NOAA or the Refuge, as project implementer, will coordinate with the State of Texas to ensure compliance with the CZMA. NOAA anticipates the State will concur that the preferred project is fully consistent with Texas Coastal Management Program goals and policies.

Endangered Species Act, 16 U.S.C. § 1531, et seq.

The purpose of the Endangered Species Act (ESA) is to conserve endangered and threatened species and the ecosystems upon which they depend. The ESA directs all federal agencies to utilize their authorities to further these purposes. Pursuant to Section 7 of the ESA, federal agencies shall, in consultation with the Secretary of the Department of the Interior and/or Commerce, ensure that any action that they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of designated critical habitat.

Under the ESA, NOAA's National Marine Fisheries Service (NFMS) and the USFWS publish lists of endangered and threatened species. Before initiating an action, the federal action agency, or its non-federal permit applicant, must ask the USFWS and/or NMFS to provide a list of threatened, endangered, proposed, and candidate species and designated critical habitat that may be present in the project area. If no species or critical habitats are known to occur in the action area, the federal action agency has no further ESA obligations under Section 7. If the federal action agency determines that a project may affect a listed species or designated critical habitat, consultation is required.

If the federal action agency concludes that the project will not adversely affect listed species or critical habitat, the agency submits a "not likely to adversely affect" determination to the USFWS and/or NMFS. If the USFWS and/or NMFS concur with the federal action agency's determination of "not likely to adversely affect," then the consultation (informal to this point) is completed and the decision is put in writing.

If the federal action agency determines that the project is likely to adversely affect either a listed species or its critical habitat, then more formal consultation procedures are required. There is a designated period in which to consult (90 days), and beyond that, another set period for the USFWS and/or NMFS to prepare a biological opinion (45 days). The determination of whether or not the proposed action would be likely to jeopardize the species or adversely modify its critical habitat is contained in the biological opinion. If a jeopardy or adverse modification determination is made, the biological opinion must identify any reasonable and prudent alternatives that could allow the project to move forward.

Several federally listed threatened or endangered species occur in Galveston and Chambers counties, and individuals may occasionally be found in the area of the proposed alternative. However, NOAA does not believe that the proposed restoration project will adversely affect any listed species or critical habitat. Rather, the project will improve the overall biological function of the site. Adverse impacts are particularly unlikely because the site is infrequently used by listed species and because any adverse effects of the techniques to be employed in project construction are minor enough to be considered insignificant. NOAA anticipates that consultations with the USFWS and the NMFS for review of this Draft DARP/EA will confirm this determination. Finally, projects of the type proposed herein are also contemplated in the Management Plan for the Texas Chenier Plain National Wildlife Refuge Complex, which has undergone complete NEPA review and approval by the USFWS, including review of potential effects to listed ESA species and their habitats.

Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1801, et seq.

The federal Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) as amended and reauthorized by the Sustainable Fisheries Act of 1996 establishes a program to promote the protection of essential fish habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. After EFH has been described and identified in fishery management plans by the regional fishery management councils, federal agencies are obligated to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH.

NOAA does not believe that the preferred restoration project will adversely affect EFH. NOAA and/or the USFWS will conduct any required consultations.

Fish and Wildlife Coordination Act*, *16 U.S.C.§ 661, et seq.

The Fish and Wildlife Coordination Act (FWCA) provides the basic authority for the USFWS involvement in the evaluation of impacts to fish and wildlife from proposed water resource development projects. The FCWA requires that federal agencies consult with the USFWS (and/or NOAA Fisheries as may be appropriate) and state wildlife agencies for activities that affect, control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA or other federal permit, license or review requirements.

If necessary, NOAA and/or the USFWS will conduct any consultations required under the FWCA.

Marine Mammal Protection Act, 16 U.S.C. § 1361, et seq.

The Marine Mammal Protection Act (MMPA) prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. The Secretary of Commerce is responsible for the conservation and management of pinnipeds (other than walruses) and cetaceans. The Secretary of Commerce delegated MMPA authority to NOAA's NMFS. The Secretary of the Interior (through the USFWS) is responsible for walruses, sea and marine otters, polar bears, manatees, and dugongs. Title II of the MMPA established an independent Marine Mammal Commission (and its Advisory Committee) which provides independent oversight of the marine mammal conservation policies and programs being carried out by federal regulatory agencies. The Commission is charged with developing, reviewing and making recommendations on domestic and international actions and policies of all federal agencies with respect to marine mammal protection and conservation and with carrying out a research program. The MMPA provides for several exceptions to the moratorium on taking and importation of marine mammals and marine mammal products. The Secretary may issue permits for take or importation for purposes of scientific research, public display, photography for educational or commercial purposes, enhancing the survival or recovery of a species or stock, importation of certain polar bear parts taken in sports hunting in Canada, and incidental taking in the course of commercial fishing operations.

NOAA does not believe that the preferred restoration project has the potential to result in the take, injury, or harassment of any species protected under the MMPA.

Migratory Bird Treaty Act of 1918, 16 U.S.C. § 703, et seq.

The Migratory Bird Treaty Act (MBTA) implements four international treaties involving protection of migratory birds, including all marine birds, and is one of the earliest statutes to provide for avian protection by the federal government. The MBTA generally prohibits actions to "pursue, hunt, take, capture, kill, attempt to take, kill, possess, offer for sale, sell, offer to purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird...or any part, nest, or egg of such bird." Exceptions to these prohibitions are only allowed under regulations or permits issued by USFWS. Hunting of migratory game birds is regulated annually through a process in which the USFWS sets "framework regulations" and "special regulations" designed to maintain sustainable hunting levels. Framework regulations are the foundation of annual regulations and consist of the outside dates for opening and closing seasons, season length, daily bag and possession limits, and shooting hours. Special regulations consist of framework regulations that are applied on a small scale and consist of split seasons, zones and special seasons, state regulations conform to the federal regulations. All other actions prohibited by the MBTA are only allowed under specific permits issued by the USFWS Regional Bird Permit Offices. These permits include special use permits for rehabilitation, possession and salvage of oiled birds during spill response, which usually provides the primary data for determining extent of injury to marine birds and the need for restoration.

Implementation of proposed restoration project would be conducted in full compliance with the MBTA.

Executive Order 13112 - Invasive Species

The 1999 Executive Order 13112 requires that all federal agencies whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law, (1) identify such actions, and (2) take actions specified in the Order to address the problem consistent with their authorities and budgetary resources; and (3) not authorize, fund, or carry out actions that they believe are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, "pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

NOAA does not believe that the proposed restoration project has the potential to cause or promote the introduction or spread of invasive species.

Executive Order (EO) 12898 - Environmental Justice

The 1994 Executive Order 12898 requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. In the memorandum to heads of departments and agencies that accompanied executive Order 12898, the President specifically recognized the importance of procedures under NEPA for identifying and addressing environmental justice concerns. The memorandum states that "each federal agency shall analyze the environmental effects, including human health, economic and social effects, of federal actions, including effects on minority communities and low-income communities, when such analysis is required by [NEPA]." The memorandum particularly emphasizes the importance of NEPA's public participation process, directing that "each federal agency shall provide opportunities for community input in the NEPA process." Agencies are further directed to "identify potential effects and mitigation measures in consultation with affected communities, and improve the accessibility of meetings, crucial documents, and notices." The CEQ has oversight of the federal government's compliance with Executive Order 12898 and NEPA.

NOAA does not believe that the proposed project will have any adverse impacts on minority and/or low-income communities.

Information Quality Law, Public Law 106-554, § 515

Information disseminated by federal agencies to the public after October 1, 2002, is subject to information quality guidelines developed by each agency pursuant to §515 of Public Law 106-554 that are intended to ensure and maximize the quality of the objectivity, utility and integrity of such information. This DARP/EA is an information product covered by information quality guidelines established by NOAA for this purpose. The quality of the information contained herein is consistent with these guidelines, as applicable.

CHAPTER 8 ACKNOWLEDGEMENTS

8.1 PREPARERS

The following personnel participated in the drafting of this DARP/EA:

NOAA Assessment and Restoration Division, National Ocean Service
Troy Baker
Sandra Arismendez
Anthony Dvarskas
Adam Domanski

NOAA Restoration Center, National Marine Fisheries Service
Kristopher Benson
John Rapp

NOAA Office of General Counsel, Natural Resources Section
Christopher J. Plaisted

8.2 LIST OF AGENCIES/PERSONS CONSULTED

NOAA acknowledges the assistance of the following individuals for providing expertise during injury assessment and restoration planning:

FEDERAL GOVERNMENT AGENCIES

NOAA
G. P. Schmahl
Heather Young
Rusty Swafford

U.S. Coast Guard
LTJG Amy McElRoy
Dr. James Hoff
Eugene Elliott

U.S. Fish and Wildlife Service
Tammy Ash
Jimmy Laurent

U.S. Department of Agriculture
Eddie Seidensticker

STATE GOVERNMENT AGENCIES

Texas Commission on Environmental Quality
Richard Seiler

Texas Parks and Wildlife Department
Don Pitts
Jim Sutherlin

Texas General Land Office
Tommy Mobley

Louisiana Oil Spill Coordinator's Office
Gina Saizan

PRIVATE ORGANIZATIONS

Cardno ENTRIX
Dr. Ralph Markarian
Christopher Pfeifer

Galveston Bay Foundation
Philip Smith

University of North Carolina at Chapel Hill
Dr. Charles Peterson

Texas A&M University at Corpus Christi
Dr. Paul Montagna

LITERATURE CITED

Broome, S.W. 1990. Creation and restoration of tidal wetlands of the southeastern United States. Pp. 37-72. In J.E. Kusler and M.E. Kentula (eds.) Wetland creation and restoration: the status of the science. Island Press, Washington, D.C.

Broome, S.W. 1986. Long-term growth and development of transplants of the salt marsh grass Spartina alterniflora. Estuaries 9:63.

Cammen, L.M. 1976. Macroinvertebrate colonization of Spartina marshes artificially established on dredge spoil. Estuarine and Coastal Marine Science 4:357-372.

Craft, C., J. Reader, J.N. Sacco, and S.W. Broome, 1999;. Twenty-five years of ecosystem development of constructed Spartina alterniflora (Loisel) marshes. Ecological Applications 9(4):1405-1419.

Currin, C.A., S.Y. Newell, and H.W. Paerl. 1995. The role of standing dead Spartina alterniflora and benthic microalgae in salt marsh food webs: considerations based on multiple stable isotope analysis. Marine Ecology Progress Series 121:99-116.

DE, NJ, & PA Natural Resource Trustees. 2009. Final Damage Assessment and Restoration Plan and Environmental Assessment for the Athos I Oil Spill.

ENTRIX, Inc. 2007. T/B DBL 152 Incident; Oil Budget / Mass Balance – Version 1.2. July 10, 2007. Prepared on behalf of K-Sea Transportation LP for submission to the U.S. Coast Guard. 8 pp.

ENTRIX, Inc. 2010. Draft Tank Barge DBL 152 Incident Response, Environmental Unit Report. 85 pgs, plus appendices.

Gulf of Mexico Fishery Management Council. 1998. Generic Amendment for Addressing Essential Fish Habitat Requirements in the Following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico United States Waters; Red Drum Fishery of the Gulf of Mexico; Reef Fish Fishery of the Gulf of Mexico; Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic; Stone Crab Fishery in the Gulf of Mexico; Spiny Lobster in the Gulf of Mexico and South Atlantic; Coral and Coral Reefs of the Gulf of Mexico. Tampa, FL.

Gulf of Mexico Fishery Management Council. 2005. Generic Amendment Number 3 for Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing in the Following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico United States Waters; Red Drum Fishery of the Gulf of Mexico; Reef Fish Fishery of the Gulf of Mexico; Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic; Stone Crab Fishery in the Gulf of Mexico; Spiny Lobster in the Gulf of Mexico and South Atlantic; Coral and Coral Reefs of the Gulf of Mexico. Tampa, FL.

LaSalle, M.W., M.C. Landin, and G.S. Jerre. 1991. Evaluation of the flora and fauna of a Spartina alterniflora marsh established on dredged material in Winyah Bay, South Carolina. Wetlands 11:191—208.

Langis, R., M.Zalejko, and J.B. Zedler. 1991. Nitrogen assessments in a constructed and a natural salt marsh of San Diego Bay. Ecological Applications 1:40-51.

Levin, L.A., D. Talley, and G. Thayer. 1996. Succession of macrobenthos in a created salt marsh. Mar. Ecol. Prog. Ser. 141:67-82.

Lindau, C.W. and L.R. Hossner, 1981. Substrate characterization of an experimental marsh and three natural marshes. Soil Science, American Journal 45:1171-1176.

Minello, T.J. 1999. Nekton densities in shallow estuarine habitats of Texas and Louisiana and the identification of essential fish habitat. American Fisheries Society Symposium 22:43-75.

Minello and Webb, 1997. Use of natural and created Spartina alterniflora salt marshes by fishery species and other aquatic fauna in Galveston Bay, Texas USA. Marine Ecology Progress Series 151:165-179.

Moy, L.D. and L.A. Levin. 1991. Are Spartina marshes a replaceable resource? A functional approach to evaluation of marsh creation efforts. Estuaries 14:1-16.

National Oceanic and Atmospheric Administration. 1996. Injury Assessment: Guidance Document for Natural Resource Damage Assessment under the Oil Pollution Act of 1990. Damage Assessment & Restoration Program, Silver Spring, MD.

National Oceanic and Atmospheric Administration. 1997. Scaling Compensatory Restoration Actions: Guidance Document for Natural Resource Damage Assessment Under the Oil Pollution Act of 1990. Damage Assessment and Restoration Program. Silver Spring, MD.

National Oceanic and Atmospheric Administration. 2004. Screening Quick Reference Table for Organics. National Ocean Service. Seattle, Washington.

National Oceanic and Atmospheric Administration. 2011. National Ocean Service. Baton Rouge, Louisiana.

Parker, R. H., A. L. Crowe and L. S. Bohme. 1980. Describe living and dead benthic (macro- and meio-) communities. Vol. I. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-25, 103 p. Available from NTIS, Springfield, VA.

Peck, M.A., P.E. Fell, E.A. Allen, J.A. Gieg, C.R. Guthke and M.O. Newkirk. 1994. Evaluation of tidal marsh restoration: comparison of selected macroinvertebrate populations on a restored impounded valley marsh and an unimpounded valley marsh within the same salt marsh system in Connecticut, USA. Environmental Management 18:183-293.

Peterson, C.H., M. Wong, M.F. Piehler, J.H. Grabowski, R.R. Twilley, and M.S. Fonseca. 2007. Estuarine habitat productivity ratios at multiple trophic levels. Final Report to NOAA Office of Response and Restoration, Assessment and Restoration Division, Silver Spring, MD. 62 pp.

Scatolini, S.R. and J.B. Zedler. 1996. Epibenthic invertebrates of natural and constructed marshes in San Diego Bay. Wetlands 16:24-37.

Seneca E.D., S.W. Broome, and W.W. Woodhouse, Jr. 1985. The influence of duration-of-inundation on development of a man-initiated Spartina alterniflora Loisel marsh in North Carolina. J. Exp. Mar. Biol. Ecol. 94:259-268.

Thompson, S.P., H.W. Paerl, and M.C. Go. 1995. Seasonal patterns of denitrification in a natural and a restored salt marsh. Estuaries 18:399-408.

TX Natural Resource Trustees. 2001. Final Damage Assessment and Restoration Plan and Environmental Assessment for the Point Comfort/Lavaca Bay NPL Site.

United States Fish & Wildlife Service. 2008. Final Environmental Impact Statement, Comprehensive Conservation Plan, and Land Protection Plan. National Wildlife Refuge System, Southwest Region. Albuquerque, New Mexico.