FINAL 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)

June 2016

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, anadromous 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 selected by NOAA were described in a Draft Damage Assessment and Restoration Plan/Environmental Assessment (Draft DARP/EA). That Draft DARP/EA was developed by NOAA and released for public comment in March 2013. Following the completion of the public comment period in April 2013, NOAA considered the public's response and prepared this Final DARP/EA.

What was injured?

Injury to benthic invertebrates, and potentially demersal fishes, pelagic fishes, and marine mammals, was caused by 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 selected 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 in the Draft DARP/EA. 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 would 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 selected restoration alternative?

NOAA considered eight 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. Seven were discussed in the Draft DARP/EA, and one was added, at the request of the State of Louisiana, following release of the Draft DARP/EA for public comment. 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. NOAA identified an estuarine shoreline protection and marsh creation project as its preferred restoration alternative in the Draft DARP/EA. 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. Following the completion of the public comment period in April 2013, NOAA considered the public's response and selected the preferred restoration alternative. NOAA anticipates presenting the selected restoration alternative to the National Pollution Funds Center (NPFC) for the costs of conducting the natural resource damage assessment and the costs of implementing the selected restoration alternative.

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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 Final Damage Assessment and Restoration Plan/Environmental Assessment (Final 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 would 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 Final DARP/EA only considers project alternatives with a connection between the natural resources and services injured and the resources and services to be restored.

NOAA sought the public's input on the preferred restoration alternative presented in the March 2013 Draft DARP/EA. Following the completion of the public comment period, NOAA considered the public's response and selected the preferred restoration alternative from the Draft DARP/EA. Throughout this Final DARP/EA, the restoration alternative NOAA selected will be referred to as the "selected restoration alternative" or "selected alternative." With the completion of the Final DARP/EA, NOAA anticipates presenting 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.

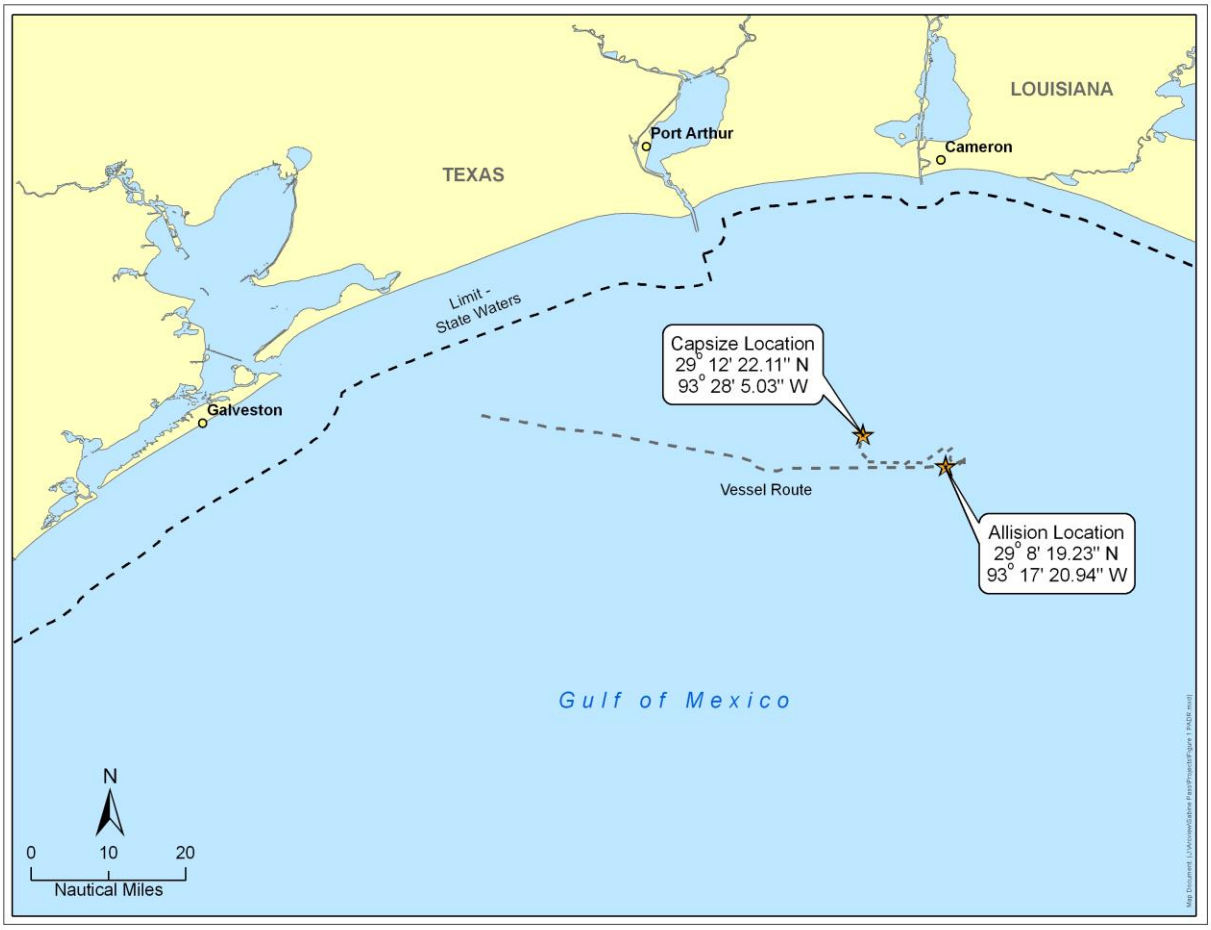

Figure 1. Location of T/B DBL 152 Incident. Graphic Credit: ENTRIX, Inc.

1.2 DETERMINATION OF JURISDICTION TO CONDUCT NATURAL RESOURCE DAMAGE ASSESSMENT

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 determined for this Incident 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 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 the Draft DARP/EA was an integral component of the restoration planning phase. Through the public review process, NOAA sought comment on the alternatives proposed to restore injured natural resources and replace lost services. The Draft DARP/EA was made available to the public during a comment period that began on March 18, 2013, and ended on April 15, 2013. Public review of the Draft DARP/EA was conducted pursuant to 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 NEPA regulations (40 CFR 1500 *et seq.*).

Following the completion of the public comment period, NOAA considered the public's response and selected the preferred restoration alternative from the Draft DARP/EA. This decision is reflected in this Final DARP/EA.

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 would 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 Final DARP/EA is provided in Appendix A. 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 selected action 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 selected restoration alternative, described in this Final DARP/EA, is needed 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 a Draft DARP/EA presenting the preferred alternative to the public. Following completion of the public comment period, NOAA considered the public response and selected the preferred alternative from the Draft DARP/EA.

With the 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 selected restoration alternative.

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. The 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 would 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.

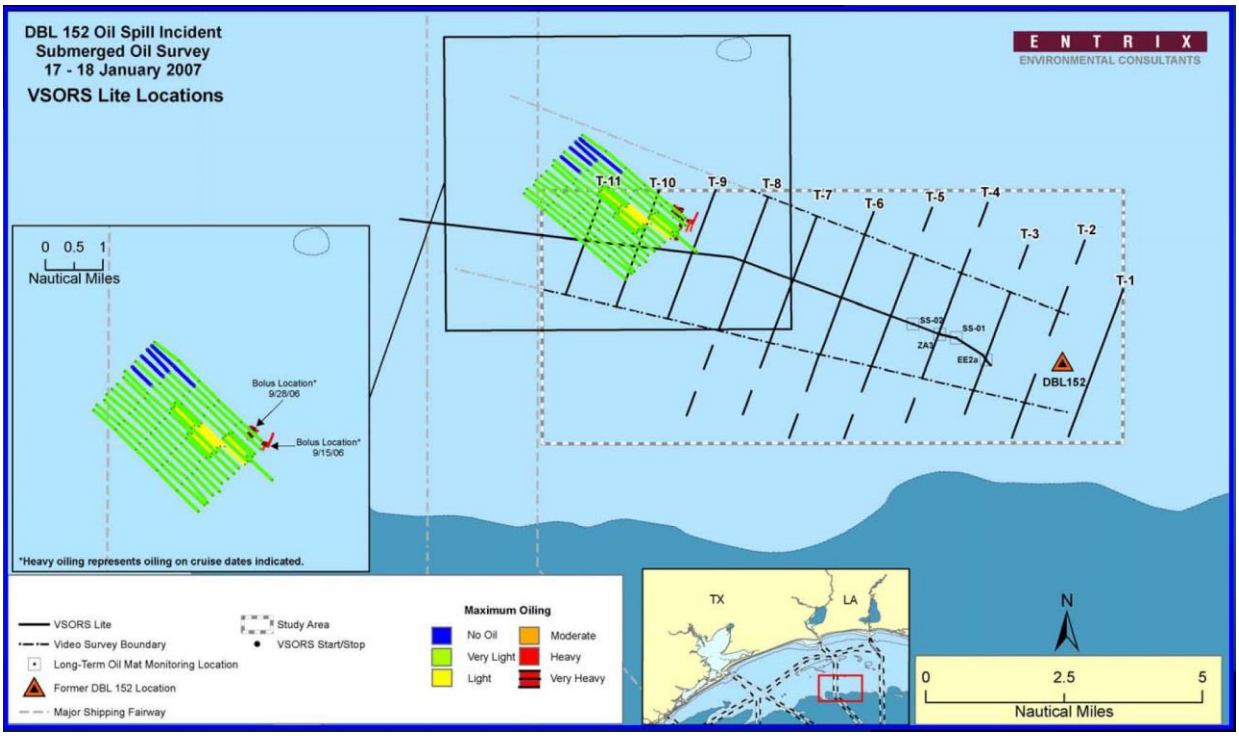

Figure 4. Submerged oil surveys undertaken Jan. 17-18, 2007. Graphic Credit: ENTRIX, Inc.

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.

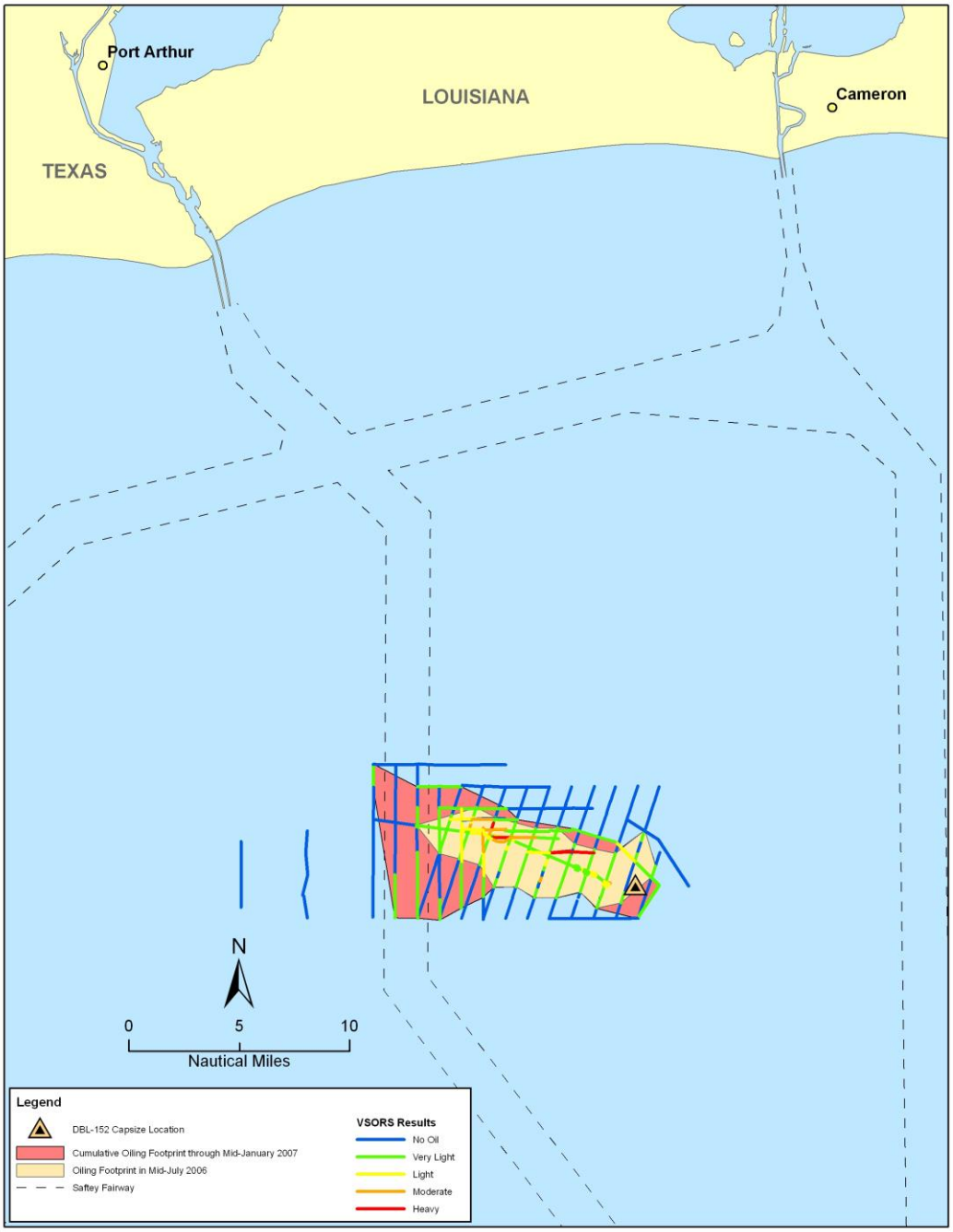

Figure 5. Cumulative extent of submerged oil based on V-SORS results during response and long-term monitoring. Graphic Credit: ENTRIX, Inc.

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 quantifiable 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 during the response phase 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.

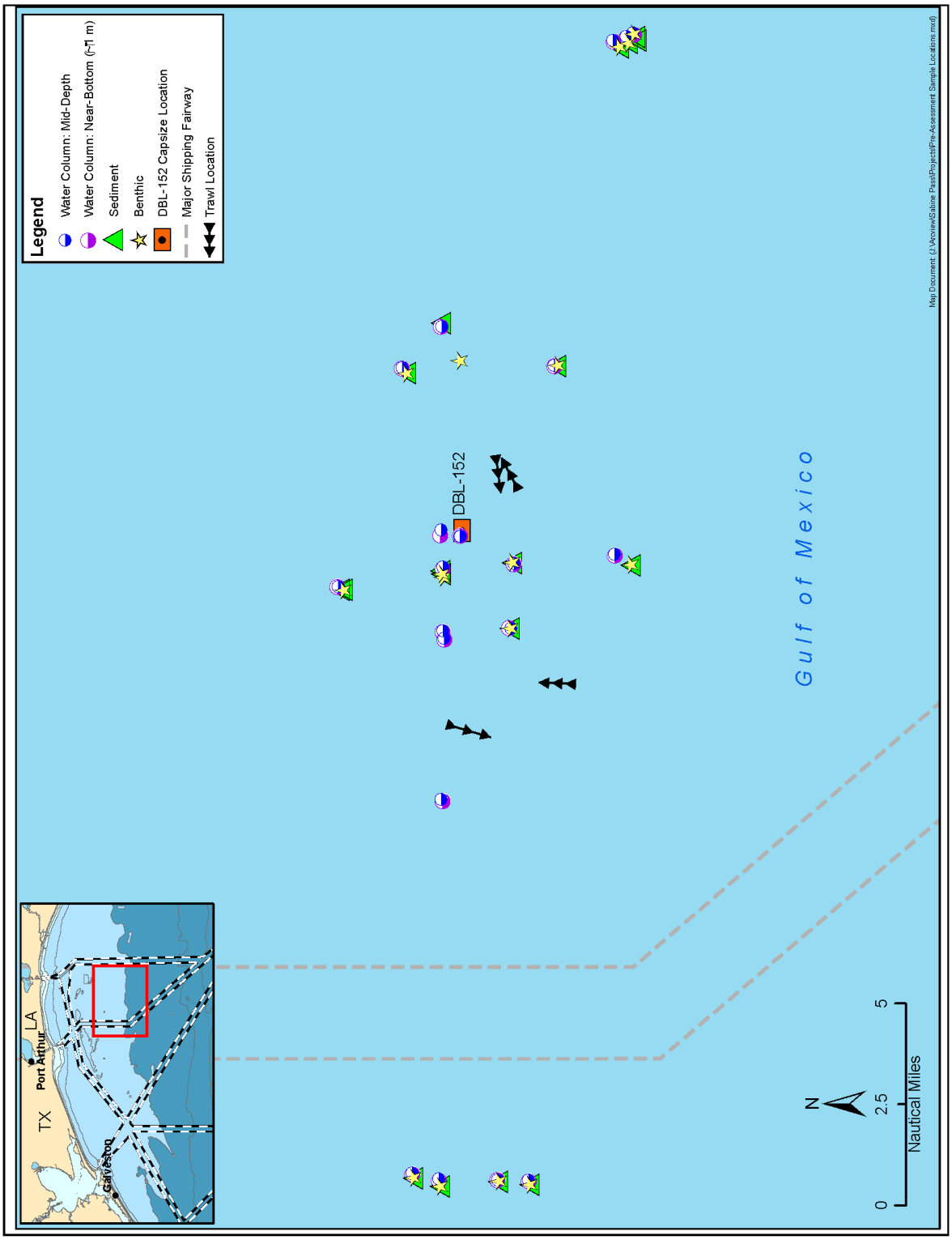

Figure 6. Preassessment water column, sediment chemistry, benthic community, and trawl sample collection locations.

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 and potential injuries to 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. Quantifiable 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 accelerate natural recovery periods or are 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 anemones 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 selected 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 would 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 selected to compensate for these losses involves shoreline protection with rip-rap wave-breaks and creation of salt marsh (how this project was selected 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 selected 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 the 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), were 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 selected restoration action 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 Final 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 2010 Deepwater Horizon/BP Oil Spill (Deepwater Horizon) when characterizing the environment affected by the DBL 152. Both spills affected the Gulf of Mexico. However, the two incidents were distant from each other spatially as well as temporally. Deepwater Horizon occurred in 2010 at around the time the resources injured by the DBL 152 were approaching full recovery. The DBL 152 oil spill occurred offshore approximately 35 to 50 miles southeast of the Texas/Louisiana border, while Deepwater Horizon occurred nearly due south of and over 300 miles away from the Louisiana/Mississippi border. Based on what is currently known about the two spills, and considering their temporal and spatial distance, NOAA was unable to quantify any overlapping impacts that would be relevant in measuring injury and scaling restoration for the DBL 152.

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).

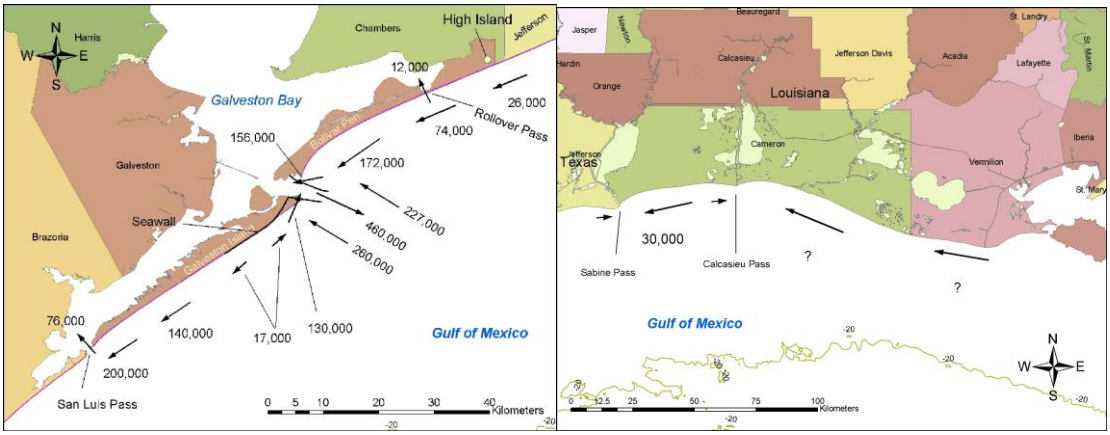

Figure 7. Sediment movement along the coast of southwestern Louisiana and southeast Texas. Arrows show the direction of sediment movement, and numbers represent net transport in cubic meters per year (USACE 2007).

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 selected restoration project 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, storm erosion, 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 selected restoration project 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 Chambers County, Texas, where the selected restoration project site is located. Though numerous endangered and threatened species are seasonal or occasional visitors to the Incident location or to the East Galveston Bay coastal ecosystem, endangered and threatened species are not known to use habitats present near the selected restoration project site . 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 selected restoration 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 Chambers County, Texas.

Common Name	Scientific Name	Federal Status
red knot	*Calidris canutus rufa*	Threatened
piping plover	*Charadrius melodus*	Threatened
green sea turtle	*Chelonia mydas*	Threatened
loggerhead sea turtle	*Caretta caretta*	Threatened
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
leatherback sea turtle	*Dermochelys coriacea*	Endangered
West Indian manatee	*Trichechus manatus*	Endangered

4.5 ESSENTIAL FISH HABITAT

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 selected 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 selected 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 selected restoration project area.

In addition to being designated EFH for the federally managed species listed below, the subtidal and intertidal zones of the selected 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 selected 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	nearshore drift algae nearshore drift algae nearshore drift algae

	Late Juvenile Adults Spawning adults	nearshore drift algae, 10-100m nearshore and offshore sand/shell, 10-100m nearshore and offshore sand/shell, 10-100m
Greater amberjack (*Seriola dumerili*)	Eggs Larvae Post Larval Early Juvenile Late Juvemile Adults Spawning adult	offshore pelagic, 1-360m 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 (*Sphyrna lewini*)	neonate/young of year	estuaries, nearshore, and offshore
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 Final 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 would 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 selected alternative and the non-selected 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 Final 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 would compensate the public for the injuries to offshore benthic resources impacted by the Incident.

In the Draft DARP/EA, NOAA identified seven restoration alternatives that exhibited sufficient geographic and ecological nexus to the injured habitat to warrant a full analysis. In this Final DARP/EA, NOAA also considers an eighth project proposed by the State of Louisiana. 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 selected 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 considered in the Draft DARP/EA were from Galveston Bay to Sabine Lake, and, with the inclusion of the Louisiana project in this Final DARP/EA, to the Calcasieu Ship Channel) 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:

- ***Selected 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 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.
- *Oyster Bayou Marsh Restoration*: This alternative was evaluated following the release of the Draft DARP/EA at the request of the State of Louisiana. It involves marsh creation through the placement of contained dredged material, nourishment of existing salt marsh, and the creation of terraces to restore marsh elevations and reduce wave- and wake-induced erosion.

The selected 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 selecting this alternative and the evaluation of the remaining non-selected alternatives.

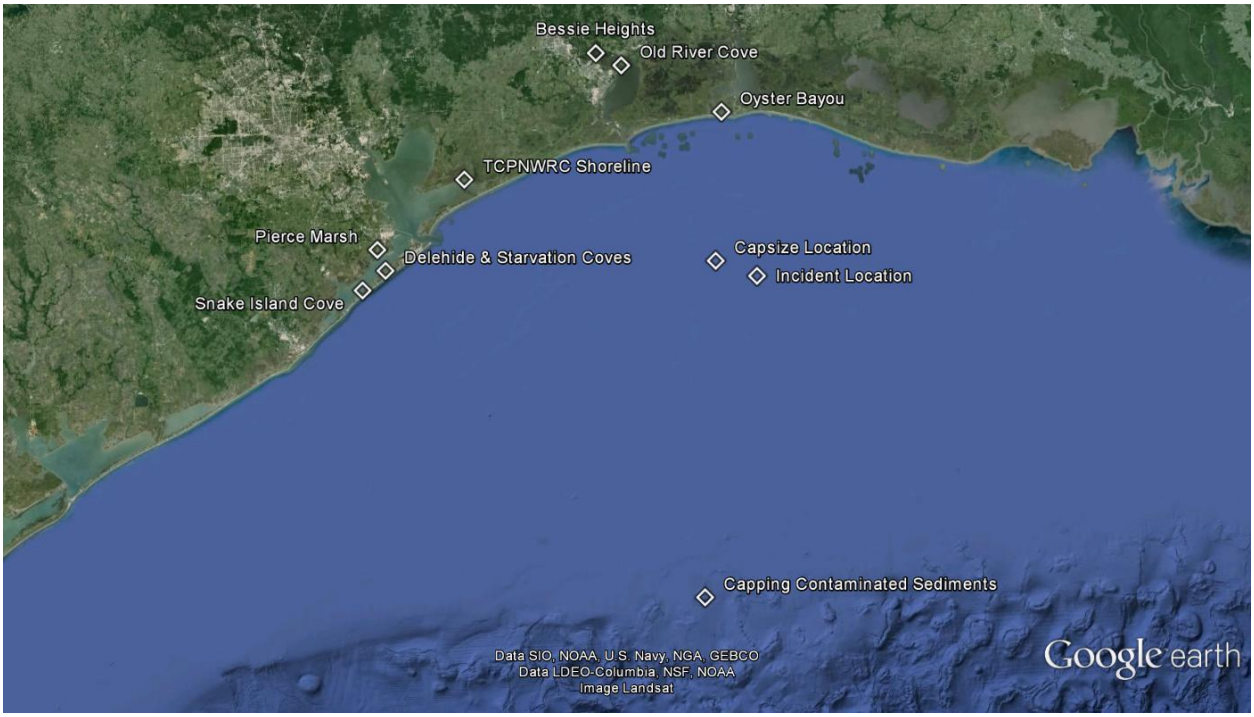

Figure 8: Approximate location of restoration project alternatives that were considered.

CHAPTER 6: EVALUATION OF REASONABLE RANGE OF RESTORATION ALTERNATIVES

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

6.1 SUMMARY OF SELECTED ALTERNATIVE

The compensatory restoration alternative selected 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. Prior to implementation, the project would 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 selected 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 would be designed to protect at least 4.23 miles of shoreline. The protective structure would consist of 8.97 acres of rip-rap habitat, and 11.55 acres of salt marsh habitat would be created behind the breakwater. The project would 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 selected restoration alternative. Erosional scouring, associated with storms, 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.

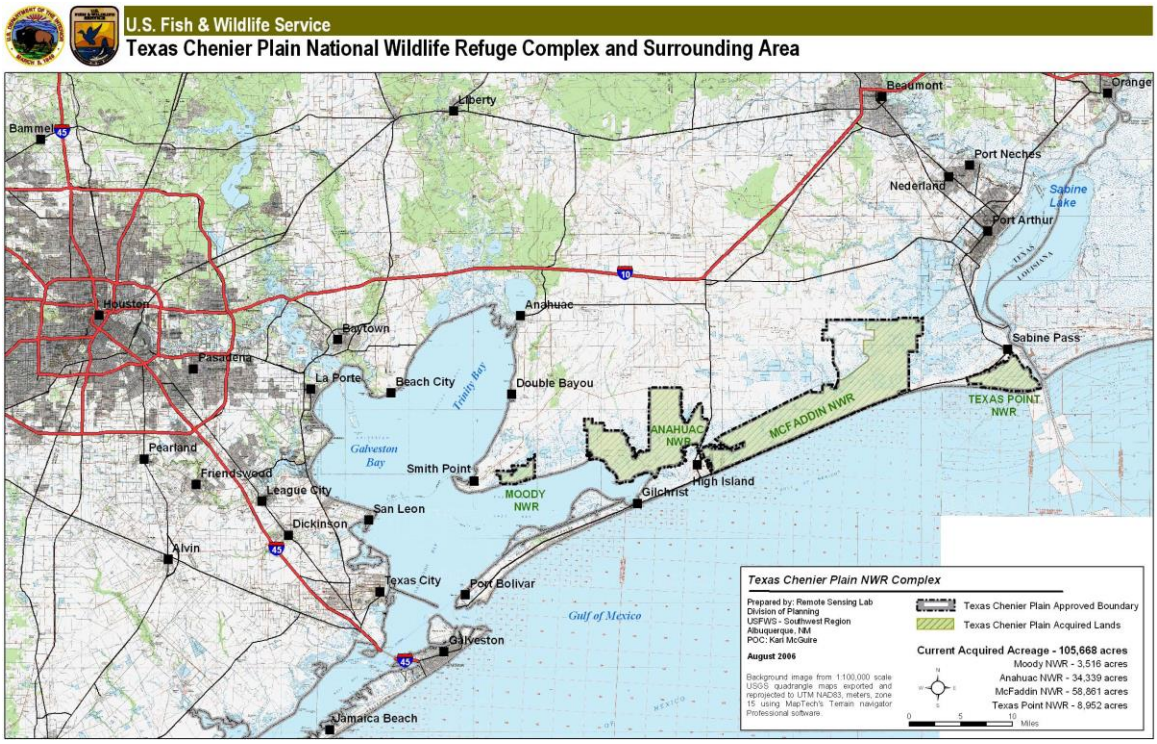

Figure 9. Location of the TCPNWRC in the context of the Galveston Bay estuary.

Independent of NOAA's current selected 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.

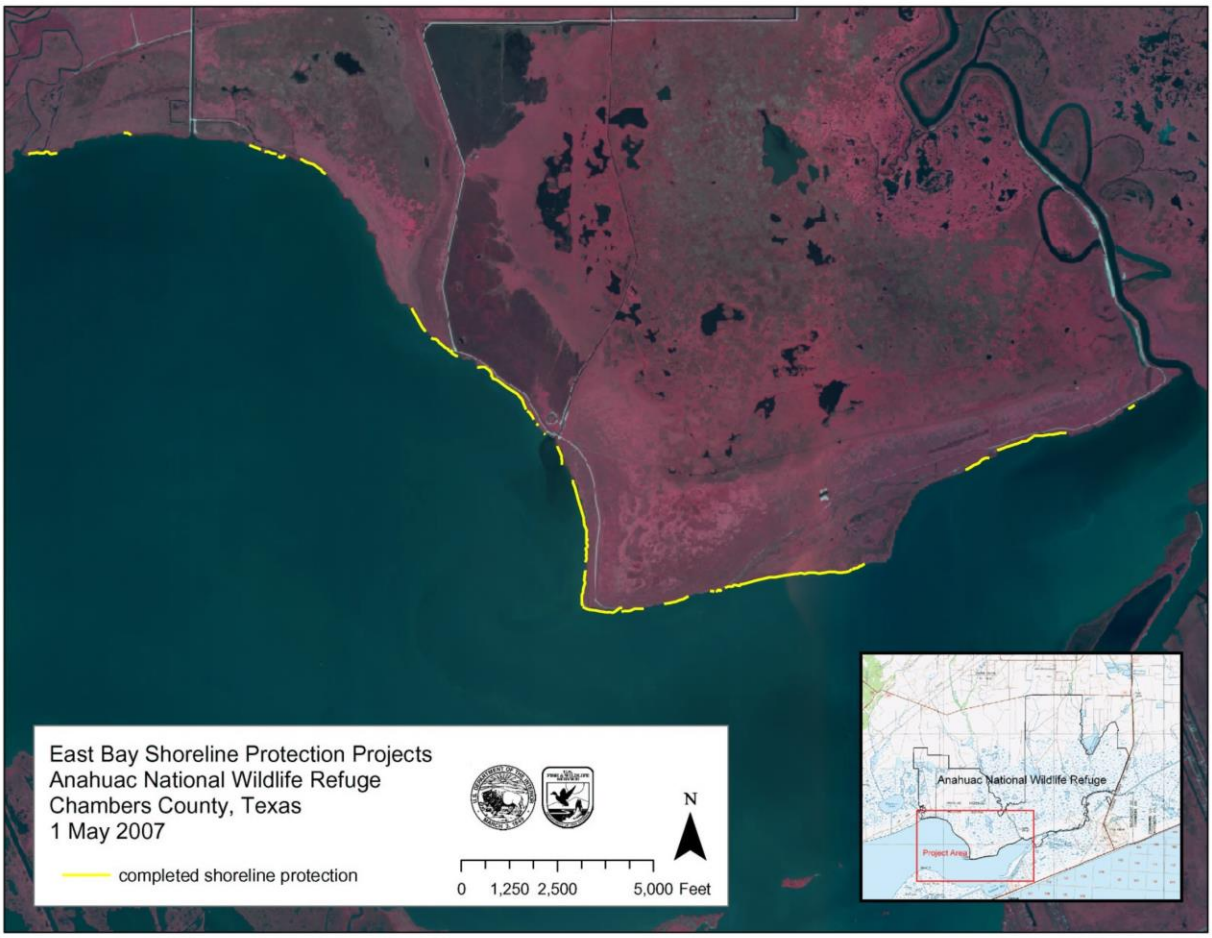

Figure 10. Shoreline protection projects completed at TCPNWRC (ANWR Unit) as of 2007.

6.1.2 RESTORATION ACTION DESCRIPTION

The proposed breakwaters would 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 would 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 would place the structures in depths no greater than -1 foot (NAVD 88), and would provide for relief from the bay bottom of at least 3 feet, allowing for a substantial structure that would 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 selected 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).

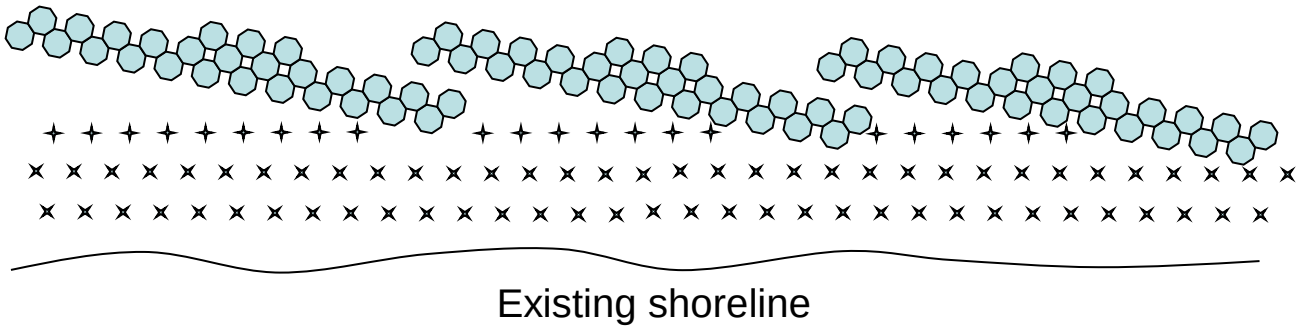

Figure 11. Conceptual rendering of the selected project design for shoreline protection and marsh restoration at the TCPNWRC. Blue circles indicate rip-rap breakwater structure and hatch marks indicate vegetation plantings.

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

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

Plants would be nursery grown and would likely be multi-stemmed. Plant spacing would 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 would serve over time to build up a shallow sloping shoreline in the project area. This would 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 would serve to accelerate this passive accretion by trapping and stabilizing sediments.

The goal of the selected 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 would 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 would 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 would 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 would 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 would 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 would take place in a shoreline area near the location of the Incident. The selected alternative also meets this criterion. This site was also selected 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 selected 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 selected 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 selected 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 selected 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 would require amendment to incorporate the shoreline of other refuge units in the complex. This would 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 would 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 would 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 selected restoration alternative presented in this Final 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 selected 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 selected action identified in this Final 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 Selected Alternative

This section provides an evaluation of the potential impacts of implementing the selected 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 would also provide areas for birds and other wildlife species to nest, forage, and seek protection. Aesthetic and recreational benefits would be extended to humans using the area. As proposed, the selected 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 would affect noise levels and the pursuit of recreational activities in the vicinity of the project area. However, these effects would 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 selected 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 selected 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*: Minor, 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 major, 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*: Minor, short-term adverse impacts, limited to the construction phase, would include increased noise associated with construction equipment. There would be no long term adverse impacts.
- *Water quality*: NOAA does not anticipate any major 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 would 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 selected project.
- *Environmental Justice*: The selected project would 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 adverse impacts to infrastructure.
- *Recreation*: No major 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 major, and the long term impact of additional wetlands would be beneficial. These long term impacts would provide enhanced recreation opportunities for visitors to the TCPNWRC, including sport fishers and hunters.
- *Traffic*: There would 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 selected project functions as intended and anticipated, adjacent wetlands would experience increased sedimentation. Impacts of this nature are expected to be beneficial since sedimentation in the wetlands would provide

nutrients important for plant growth and for maintenance of elevation. NOAA anticipates that the highly productive coastal ecosystems of the region would be enhanced by the project, and that the project would 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 selected 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 selected project. Nevertheless, the project implementation team would conduct a thorough site survey and engineering analysis, which would address any uncertainties before implementing the selected 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 selected 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 selected project. Known middens exist on the East Bay shoreline near Smith Point, to the west of the selected project, and the instability of the existing shoreline is causing these cultural resources to be lost to erosion over time. The proposed work would undergo archaeological review during construction permitting, and any needed design modifications would be made to ensure that construction would not disturb any known midden site. If cultural or historic resources are encountered during construction, the project implementation team would 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 selected restoration action identified in this Final DARP/EA would have no effect on any species listed as threatened or endangered, or habitats critical to such species, under the ESA. NOAA conferred with the USFWS and NOAA's National Marine Fisheries Service (NMFS) concurrent with public review of the Draft DARP/EA to ensure that the selected restoration action would be compliant with the ESA. Based on correspondence with those entities, the project implementation team confirmed its determination that the selected project would have no effect on any listed species.

As noted in this Final DARP/EA, several federal and state-listed species, including the red knot, the piping plover, five species of sea turtle, and the West Indian manatee may occasionally occur in East Galveston Bay, where the selected restoration action would be implemented. While the restored habitats would provide multiple ecosystem services supporting threatened and endangered species migrating through or utilizing East Galveston Bay, endangered and threatened species are not known to use habitats present near the selected restoration project site.

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 would occur in Essential Fish Habitat (EFH). As a result of construction activities, there would 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 selected 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 was initiated with the NMFS Habitat Conservation Division (HCD) during the public review and comment period for the DARP/EA. NMFS HCD provided a letter documenting their concurrence with the determination of this Final DARP/EA that the potential impacts of the project on EFH and marine fishery resources are adequately described in the document and that the selected restoration action would not have a net adverse effect on EFH.

Potential for Violation of Environmental Protection Laws

The selected 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, selected herein, would significantly impact the quality of the human environment. Accordingly, NOAA has issued a Finding of No Significant Impact (FONSI) concurrent with the publication of this Final DARP/EA.

If any information indicating the potential for significant impacts is revealed through the planning and design process for the project, 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 selected or consider a new project or projects (subject to an Environmental Assessment).

6.1.5 SCALING OF THE SELECTED 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 selected 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 selected 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 would protect 8.5 acres of marsh over the project's lifetime. This, in turn, would 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-SELECTED 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 selected for implementation, are listed in this section. While many of these non-selected 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 during planning (including engineering and design, permitting, and bid

solicitation), NOAA identifies problems with the selected restoration alternative, it may reconsider one of the non-selected alternatives that met the Section 5.2 evaluation criteria. The approximate locations of alternatives considered, but not selected, are shown in Figure 8 (Section 5.4, above), and brief descriptions and evaluations of each non-selected 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 evaluated 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 considerably higher than the total estimated cost of the selected alternative, and does not account for more complicated planning, monitoring, and administration and oversight required of this alternative. Total costs of this 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 selected 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 alternative would be similar to or higher than that of the selected 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 dredge 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 selected project 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 selected 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 project would be 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 selected alternative, are in East Galveston Bay or the Sabine Lake area. This project is not as well developed conceptually as the selected 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 dredge 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 dredge 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 on 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 selected 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.

Oyster Bayou Marsh Restoration

Project Description

This alternative would support a portion of a large project encompassing a total area of 843 acres in the Oyster Bayou system, an area in which marsh loss has resulted from altered hydrology, drought stress, saltwater intrusion and hurricane impacts. Recent impacts from Hurricane Rita in 2005 and Hurricane Ike in 2008 have resulted in the coalescence of Oyster Lake with other water bodies, increasing wave and wake related erosion. Within the 843 acre project area, 491 acres of intertidal marsh would be created through the placement of contained dredged material, 90 acres of marsh would be nourished, and 14,140 linear feet (or around 10 acres) of marsh terraces would be built to restore marsh elevations and reduce wave- and wake-induced erosion. Sediment needed for the fill would be mined approximately one and half miles offshore

from the Gulf of Mexico, while the material for terrace construction would be borrowed from adjacent open water in the project area. Half of the created acres would be planted with smooth cordgrass plugs or other appropriate saline marsh type species.

Evaluation of the Alternative

This alternative was evaluated following the release of the Draft DARP/EA at the request of the State of Louisiana. The project has a strong geographic nexus to the injury, since the site is the closest alternative to the Incident location. It also represents an important restoration objective supported by both NOAA and the state of Louisiana through the Louisiana Coastal Wetlands Conservation and Restoration Task Force. However, it is significantly less cost-effective and less readily scalable to the DBL 152 injury than the selected restoration alternative. Also, while it would create marsh habitat, the proposed technique uses offshore dredging that would negatively impact the type of habitat most directly affected by the DBL 152 oil spill.

Not all of the proposed marsh creation and restoration techniques proposed for the Oyster Bayou project would achieve the same functional benefit; however, for the purposes of this evaluation, NOAA assumes marsh productivity on a per-acre basis would be similar in the Calcasieu basin and the Galveston Bay system. Accordingly, NOAA applied to Oyster Bayou the marsh restoration credit value from the HEA developed for the selected alternative. The result shows a restoration requirement of approximately 180 acres of marsh creation to fully compensate for the DBL 152 injury (or roughly one third of the total area of marsh to be created by the Oyster Bayou project). Cost estimates for the Oyster Bayou project suggest that in order to achieve comparable restoration credits to those generated by the selected alternative, the Oyster Bayou project would require a cost increase of 33%-67% over the cost of the selected restoration alternative.

Also, unlike the selected project, Oyster Bayou cannot be readily scaled in terms of project size. In other words, NOAA can make the selected project as large or small as necessary to meet the restoration requirements. Oyster Bayou, on the other hand, must meet a certain funding threshold before the larger project can be completed. There is the potential to achieve this goal by leveraging compensatory restoration against ongoing habitat restoration supported by the Coastal Wetlands Planning, Protection, and Response Act (CWPPRA) program. This alternative could also benefit from existing engineering and design work and monitoring plans developed for the ongoing CWPPRA project. However, it is uncertain when (or whether) CWPPRA funding would be available, and, assuming these two funding sources were sufficient to build the entire project, the funds for both would need to be in hand before the project could move forward.

There would be minor environmental impacts associated with construction of the dredged material containment levees, the dredging required for marsh creation, and the marsh terrace construction. These impacts would primarily be limited to the dredging and 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 selected as primary restoration. In fact, as noted above, NOAA expects that the injured areas have already recovered, leaving only interim losses to address through compensation.

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 selected 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 selected restoration project for the DBL 152 NRDA would 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 selected 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 selected restoration project in this Final DARP/EA in conjunction with other known past, present or foreseeable future projects that could potentially add to or interact with this project within the affected area to determine whether significant cumulative impacts may occur. The selected 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.

The Refuge Management Plan identified a number of projects with existing and/or potential future impacts that could collectively add to impacts of the selected restoration project. These projects can be grouped into nine categories based upon the type of activity and the entity responsible for the activity:

1. State Highway 87 Relocation and Reconstruction;
2. State of Texas Coastal Management;
3. Fish, Wildlife, and Habitat Management on Non-FWS Lands;
4. State of Texas Regional Water Planning;
5. Navigation and Waterway Projects;
6. U.S. Army Corps of Engineers Activities;
7. Drainage District Activities;
8. Big Hill Strategic Petroleum Reserve Site; and
9. Regional Economic Development Activities.

These projects encompass a broad array of activities including: habitat and wildlife management; water management; cropland management; grazing management; prescribed burning; invasive species management; erosion control; habitat restoration; recreation improvements; vehicular access improvements; creation and repair of navigation/drainage infrastructure; oil, gas, and agriculture development; and USFWS land management.

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. As of the time this document was drafted, restoration pursuant to the Final Programmatic Damage Assessment and Restoration Plan for Deepwater Horizon is described at a programmatic rather than project-specific level. Certain early restoration projects have been identified, and two of those projects will be built in the vicinity of the selected restoration project for the DBL-152 case (Rollover Bay island and Smith Point island). The primary goal of these projects is to increase nesting of colonial waterbirds, including brown pelicans, gulls, terns (royal and sandwich terns), and wading birds (great blue herons, roseate spoonbills, reddish egrets, great egrets, snowy egrets, tricolored herons, and black-crowned night herons). Restoration actions at each rookery island will increase the amount of available nesting habitat by expanding the size of the island and enhancing the quality of habitat for nesting birds. Habitat longevity will be increased by raising the islands' elevations and constructing protective features, such as breakwaters or armoring levees. Ultimately, future project-specific restoration planning for that case may yield additional restoration projects near the selected project in this Final DARP/EA; however, the nature and details of such projects are sufficiently uncertain as to make cumulative impacts analysis at this time infeasible.

NOAA considered the cumulative effects of the selected action, actions taken by the USFWS pursuant to the Refuge Management Plan and the other management actions described in the Refuge Management Plan's analysis of cumulative impacts. Similarly, NOAA considered that many of the nearshore non-selected projects in this Final DARP/EA may be undertaken in the future by other entities.

Cumulatively, natural resource improvement projects in the Refuge Management Plan, the non-selected projects described in this Final DARP/EA, restoration actions implemented pursuant to the Deepwater Horizon NRDA settlement, 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 selected project in this Final 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.

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 Final 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 for 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 would 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 would have a significant effect, federal agencies would 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) would 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 Final 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 selected in this Final DARP/EA are also contemplated in the Management Plan for the Texas Chenier Plain National Wildlife Refuge Complex. That Refuge 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 Final 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 selected project require any amendment to an existing CWA permit, NOAA and/or USFWS (as the property manager and potential project implementer) would 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 selected 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. NOAA initiated a federal consistency consultation with the State of Texas. NOAA concluded that the selected project is consistent with Texas Coastal Management Program goals and policies. The State concurred.

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 selected 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 areas impacted by the Incident or in the East Galveston Bay coastal ecosystem, where the selected alternative would be implemented. Endangered and threatened species are not known to use habitats present near the selected restoration project site. However, the habitats in the Incident location and the selected project site provide multiple ecosystem services supporting threatened and endangered species migrating through or utilizing these communities. The NOAA case team for DBL 152 believes implementation of the selected restoration action identified in this Final DARP/EA would have no effect on any species listed as threatened or endangered, or habitats critical to such species, under the ESA. NOAA conferred with the USFWS and internally with its National Marine Fisheries Service (NMFS) concurrent with public review of this Final DARP/EA to ensure that the selected restoration action would be compliant with the ESA. Based on correspondence with those entities, the project implementation team confirmed its determination that the selected project will have no effect on any listed species. 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 selected restoration project would adversely affect EFH. The NOAA case team for DBL 152 consulted with NOAA's National Marine Fisheries Service and received concurrence with its determination that (1) substantial beneficial restoration of EFH and other important habitat in the project area would result from project implementation; (2) adverse effects of the project would be minor and temporary; and (3) any adverse effects would be alleviated by project benefits, and have been minimized to the extent practicable through design and proposed construction methods.

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 NMFS, 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 would 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 selected 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 selected 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 would be taken in conjunction with the actions."

NOAA does not believe that the selected 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 selected project would 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

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APPENDIX A:

DBL 152 OIL SPILL ADMINISTRATIVE RECORD INDEX

as of June 2016

DOCUMENT NUMBER	DOCUMENT DATE	DOCUMENT DESCRIPTION
1.		
DESIGNATION OF TRUSTEES (§ 990.11)		
1001		*Oil Pollution Act of 1990, 33 U.S.C. 2701, et seq.*
1002		*The National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300*
2.		
COORDINATION (§ 990.14)		
2.1 Coordination Among Trustees (§ 990.14(a))		
2101	04/15/2013	Letter from Karolien Debusschere, LOSCO, to Chris Plaisted, NOAA, *Re: Draft DARP/EA for Tank Barge DBL 152 Oil Spill*, 4 pages.
2102	08/08/2013	Letter from Chris Plaisted. NOAA, to Karolien Debusschere, LOSCO, *Re: Louisiana Trustee Comments on T/B DBL 152 Draft DARP/EA*, 4 pages.
2.2 Coordination with Response Agencies (§ 990.14(b))		
2201	02/28/2007	Letter from Captain T. Sparks, USCG, to Tony Penn, NOAA, 1 pg.
2.3 Coordination with Responsible Parties (§ 990.14(c))		
2.3.1 Invitation to Responsible Party and Responsible Party Response (§ 990.14(c)(1))		
2311	12/07/2006	Letter from Christopher J. Plaisted, NOAA, to Andrew Davis, RP, 2 pages.
2312	5/10/2007	Letter from Andrew Davis, RP, to Christopher J. Plaisted, NOAA, 2 pages.
2.3.2 Agreements and Agreed Upon Facts (§ 990.14(c)(3))		
2321	5/10/2007	*Guiding Principles for NOAA/K-Sea DBL-152 Cooperative Natural Resource Damage Assessment* (attachment to letter from Andrew Davis, RP, to Christopher J. Plaisted, NOAA), 3 pages.
2.3.3 Nature and Extent of Participation (§ 990.14(c)(4))		
2321 (see above)	5/10/2007	*Guiding Principles for NOAA/K-Sea DBL-152 Cooperative Natural Resource Damage Assessment* (attachment to letter from Andrew Davis, RP, to Christopher J. Plaisted, NOAA), 3 pages.

DOCUMENT NUMBER	DOCUMENT DATE	DOCUMENT DESCRIPTION
2.3.4 Considerations (§ 990.14(c)(5))		
	N/A	
2.3.5 Request for Alternative Assessment Procedures (§ 990.14(c)(6))		
2351	04/15/2013	Letter from Andrew Davis, RP, to Christopher J. Plaisted, NOAA, *Re: Commentson the Draft Damage Assessment and Restoration Plan/Environmental Assessment for the Tank Barge DBL 152 Oil Spill*, with attachment, 9 pages.
2.3.6 Termination of Coordination (§ 990.14(c)(7))		
2361	10/30/2009	Email from Andrew Davis, RP, to Christopher J. Plaisted, NOAA, *RE: DBL152/NRDA etc.*, 2 pages.
2.4 Public Involvement (§ 990.14(d))		
2401	04/08/2009	NOAA, *Notice of Intent to Conduct Restoration Planning to Evaluate Potential Injuries to Natural Resources and Services Resulting from the Discharge of Oil from the Tank Barge (T/B) DBL 152 in the Gulf of Mexico*, 3 pages.
2402	03/2013	NOAA, *Notice of Availability of a Draft Damage Assessment and Restoration Plan and Environmental Assessment for the T/B DBL 152 Oil Spill*, 3 pages.
2403	03/15/2013	NOAA, *News Release: NOAA Proposes Plan to Address Environmental Injuries from 2005 Tank Barge DBL 152 Oil Spill in Gulf of Mexic* , 2 pages.
2404	03/15/2013	NOAA, *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)*, 85 pages.
2405	06/2016	NOAA, *Final 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)*, 191 pages.
3. **PRE-INCIDENT PLANNING (§ 990.15(A))**		
	N/A	
4. **AUTHORITIES (§§ 990.23 – 990.24)**		
4.1 Compliance with NEPA (§ 990.23(a)-(c))		
2404 (see above)	03/15/2013	NOAA, *Draft Damage Assessment and Restoration Plan / Environmental Assessment for the Tank Barge DBL 152*

DOCUMENT NUMBER	**DOCUMENT DATE**	**DOCUMENT DESCRIPTION**
		Oil Spill (Federal waters of the Gulf of Mexico, beginning November 11, 2005), 85 pages.
2405 (see above)	06/2016	NOAA, *Final 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)*, 191 pages.
4.2 Compliance with Worker Health and Safety Laws (§ 990.24(a))		
	N/A	
4.3 Compliance with Natural Resource Protection Laws (§ 990.24(b))		
2404 (see above)	03/15/2013	NOAA, *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)*, 85 pages (see Chapter 7).
4301	11/25/2014	Letter from Rusty Swafford, NOAA Habitat Conservation Division, to Kristopher Benson, NOAA, *Essential Fish Habitat Consultation: NOAA Restoration Center Draft Damage Assessment and Restoration Plan/Environmental Assessment for the Tank Barge DBL 152 Oil Spill*, 1 page.
4302	12/01/2014	NOAA Restoration Center, *NOAA Restoration Center Draft Damage Assessment and Restoration Plan/Environmental Assessment for the Tank Barge DBL 152 Oil Spill – ESA & MMPA Consultation*, 3 pages.
4303	12/02/2014	NOAA Restoration Center, *NOAA Restoration Center Draft Damage Assessment and Restoration Plan/Environmental Assessment for the Tank Barge DBL 152 Oil Spill – ESA Section 7 Consultation*, 3 pages.
4304	12/02/2014	NOAA Office of General Counsel, *Federal Consistency Determination for the T/B DBL 152 Oil Spill Damage Assessment and Restoration Plan/Environmental Assessment*, 2 pages.
4305	01/29/2015	Email from Donna Anderson, USFWS, to Kristopher Benson, NOAA, *Re: ESA Section 7 Consultation "No Effect,"* 1 page.
4306	02/11/2015	Email from Chris Plaisted, NOAA, to Ray Newby, TGLO, *DBL 152 Restoration Federal Consistency Determination*, 1 page.
2405 (see above)	06/2016	NOAA, *Final Damage Assessment and Restoration Plan / Environmental Assessment for the Tank Barge DBL 152*

DOCUMENT NUMBER	DOCUMENT DATE	DOCUMENT DESCRIPTION
		Oil Spill (Federal waters of the Gulf of Mexico, beginning November 11, 2005), 191 pages (see Chapter 7).
4.4 Settlement (§ 990.25)		
	N/A	
4.5 Emergency Restoration (§ 990.26)		
	N/A	
4.6 Use of Assessment Procedures (§ 990.27)		
2404 (see above)	03/15/2013	NOAA, *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)*, 85 pages (see Chapter 3).
2405 (see above)	06/2016	NOAA, *Final 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)*, 191 pages (see Chapter 3).
5. **RESPONSE DOCUMENTS AND DATA**		
5001	12/26/2005	Unified Command, *Final K-Sea T/B DBL 152 Incident Long-Term Monitoring Plan*, 7 pgs.
5002	4/20/2006	NOAA, *K-Sea T/B DBL 152 Incident Summary of Long-Term Monitoring Results: 18-20 APRIL 2006*, 1 page.
5003	10/2006	*Video: Heavy Oil Characterization of Seafloor*, 10 CDs.
5004	11/28/2006	Unified Command, *Final DBL 152 Oil Spill Incident Submerged Oil Verification/Calibration Survey Plan*, 6 pgs.
5005	11/28/2006	Unified Command, *Proposed Towed Video Survey Plan & Cumulative Submerged Oil Survey Results*, 1 pg.
5006	11/28/2006	Unified Command, *Final K-Sea T/B DBL 152 Incident Revised Long-Term Monitoring Plan*, 13 pgs.
5007	11/2007	Sample Log and Analytical Results Through 30 Nov 2006, 1 CD.
5008	2/8/2007	Unified Command, *Meeting Notes for the Environmental Unit Regarding Termination of Long-Term Monitoring and Completion of Response*, 3 pages.
5009	2/27/2007	Sample Log and Analytical Results Through 27 Feb 2007 and ArcGIS Geospatial Data and Supporting Files Through 27 Feb 2007, 2 CDs.

DOCUMENT NUMBER	DOCUMENT DATE	DOCUMENT DESCRIPTION
5010	2/28/2007	ENTRIX, Inc., *T/B DBL 152 Oil Spill Incident Oil Budget/Mass Balance*, 2 pages.
5011	1/19/2010	ENTRIX, Inc., *Draft Tank Barge DBL 152 Incident Response, Environmental Unit Report*, 85 pages.
2201 (see above)	02/28/2007	Letter from Captain T. Sparks, USCG, to Tony Penn, NOAA, 1 pg.
6. **PRE-ASSESSMENT PHASE (§§ 990.40 – 990.45)**		
6.1 Determination of Jurisdiction (§ 990.41) and to Conduct Restoration Planning (§ 990.42)		
2401 (see above)	04/08/2009	NOAA, *Notice of Intent to Conduct Restoration Planning to Evaluate Potential Injuries to Natural Resources and Services Resulting from the Discharge of Oil from the Tank Barge (T/B) DBL 152 in the Gulf of Mexico,* 3 pages.
6.2 Pre-assessment Data Collection (§ 990.43)		
6201	01/09/2009	NOAA/ENTRIX, Inc., *Preassessment Data Report, Tank Barge DBL 152 Oil Discharge in Federal Waters, Gulf of Mexico*, 26 pages.
6.3 Notice of Intent to Conduct Restoration Planning (§ 990.44)		
2401 (see above)	04/08/2009	NOAA, *Notice of Intent to Conduct Restoration Planning to Evaluate Potential Injuries to Natural Resources and Services Resulting from the Discharge of Oil from the Tank Barge (T/B) DBL 152 in the Gulf of Mexico,* 3 pages.
7. **RESTORATION PLANNING**		
7.1 Injury Assessment		
7.1.1 Injury Determination (§ 990.51)		
7111	12/22/2005	NOAA, *Western Gulf of Mexico Fuel Oil Spill Advisory*, 1 page.
6201 (see above)	01/09/2009	NOAA/ENTRIX, Inc., *Preassessment Data Report, Tank Barge DBL 152 Oil Discharge in Federal Waters, Gulf of Mexico*, 26 pages.
2404 (see above)	03/15/2013	NOAA, *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)*, 85 pages (see Chapter 3).
2405	06/2016	NOAA, *Final Damage Assessment and Restoration Plan /*

DOCUMENT NUMBER	**DOCUMENT DATE**	**DOCUMENT DESCRIPTION**
(see above)		*Environmental Assessment for the Tank Barge DBL 152 Oil Spill (Federal waters of the Gulf of Mexico, beginning November 11, 2005)*, 191 pages (see Chapter 3).
7.1.2 Quantification (§ 990.52)		
5010 (see above)	02/28/2007	ENTRIX, Inc., *T/B DBL 152 Oil Spill Incident Oil Budget/Mass Balance*, 2 pages.
5007 (see above)	11/2007	*Sample Log and Analytical Results Current through 30 Nov 2006*, 1 CD.
6201 (see above)	01/09/2009	NOAA/ENTRIX, Inc., *Preassessment Data Report, Tank Barge DBL 152 Oil Discharge in Federal Waters, Gulf of Mexico*, 26 pages.
5010 (see above)	02/28/2007	ENTRIX, Inc., *T/B DBL 152 Oil Spill Incident Oil Budget/Mass Balance*, 2 pages.
6201 (see above)	01/09/2009	NOAA/ENTRIX, Inc., *Preassessment Data Report, Tank Barge DBL 152 Oil Discharge in Federal Waters, Gulf of Mexico*, 26 pages.
7.2 Restoration Selection		
7.2.1 Developing Restoration Alternatives (§ 990.53)		
7211	07/1/2011	Troy Baker and Sandra Arismendez, NOAA, *Conversion Factor Between Offshore Benthic Habitat and Marsh Habitat in the DBL 152 Oil Spill*, 5 pages
7212	06/06/2007	Memo from John Rapp, NOAA, to Ralph Markarian and Chris Pfeifer, ENTRIX/RP, *DBL-152 Restoration Alternative Identification – Preliminary Steps*, 3 pages.
7213	06/2008	USF&WS, *Texas Chenier Plain Refuge Complex: Moody National Wildlife Refuge; Anahuac National Wildlife Refuge; McFaddin National Wildlife Refuge; Texas Point National Wildlife Refuge. Final Environmental Impact Statement, Comprehensive Conservation Plan, and Land Protection Plan*, 2 volumes.
7214	08/13/2011	NOAA, *Oyster Bayou Marsh: Restoration Candidate Project for the Twenty First Priority Project List of the Coastal Wetlands Planning, Protection and Restoration Act*, 24 pages
2404 (see above)	03/15/2013	NOAA, *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)*, 85 pages (see Chapter 5).

DOCUMENT NUMBER	**DOCUMENT DATE**	**DOCUMENT DESCRIPTION**
2405 (see above)	06/2016	NOAA, *Final 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)*, 191 pages (see Chapter 5).
7.2.2 Evaluation of Alternatives (§ 990.54)		
2404 (see above)	03/15/2013	NOAA, *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)*, 85 pages (see Chapter 5).
2405 (see above)	06/2016	NOAA, *Final 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)*, 191 pages (see Chapter 5).
8. **RESTORATION PLANNING: DEVELOPING RESTORATION PLANS (§ 990.55)**		
2404 (see above)	03/15/2013	NOAA, *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)*, 85 pages.
2405 (see above)	XX/XX/XXXX	NOAA, *Final 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)*, XX pages.
9. **RESTORATION PLANNING: MISCELLANEOUS**		
9.1 Use of a Regional Restoration Plan or Existing Restoration Project (§ 990.56)		
	N/A	
10. **RESTORATION IMPLEMENTATION: PRESENTING A DEMAND (§ 990.62)**		
	N/A	
11. **REFERENCES AND LITERATURE**		

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12. **MISCELLANEOUS**		
	N/A	

Appendix B. Response to Comments

This appendix contains summaries of and/or excerpts from comments received from the public and NOAA's responses to those comments. Comments are summarized where there were multiple comments that addressed overlapping issues. A complete copy of all written public comments is provided in Appendix C.

1. Overlap of Injury with the Deepwater Horizon (DWH) Oil Spill – The Louisiana Oil Spill Coordinator's Office (LOSCO), on behalf of the Louisiana Natural Resource Trustees, commented as follows:

> "Since April of 2010, the Louisiana Trustees and NOAA (as well as several other state and federal natural resource trustees) have been working together in responding to and conducting a natural resource damage assessment (NRDA) for the Deepwater Horizon Oil Spill. In the DBL 152 Incident DARP/EA, NOAA states that while it considered the impacts of the Deepwater Horizon Oil Spill on the environment affected by the DBL 152 Incident, "NOAA concluded that there were likely few, if any, overlapping impacts between the two spills." The Deepwater Horizon Oil Spill is unprecedented in its scope and scale, including its duration, spatial extent, volume of oil spilled, and volume of oil still remaining in the environment. The NRDA for the Deepwater Horizon Oil Spill is ongoing and may be ongoing for many years to come. Any conclusory statement by NOAA that limits potential overlapping impacts from these two spills is premature."

NOAA RESPONSE - NOAA appreciates the concerns raised by LOSCO and agrees that the DWH spill is an unprecedented disaster, the full impacts of which are not yet known. Statements in the DBL 152 Draft DARP/EA regarding overlapping effects were not intended as a limitation on the magnitude of DWH impacts. It is perhaps more accurate to say that, based on what is currently known about the two spills, and considering their temporal and spatial distance, NOAA identified no overlap that would be relevant in measuring injury and scaling restoration for DBL. Accordingly, NOAA has revised the relevant paragraph as follows:

> "NOAA considered the 2010 Deepwater Horizon/BP Oil Spill (Deepwater Horizon) when characterizing the environment affected by the DBL 152. Both spills affected the Gulf of Mexico. However, the two incidents were distant from each other spatially as well as temporally. Deepwater Horizon occurred in 2010 at around the time the resources injured by the DBL 152 were approaching full recovery. The DBL 152 oil spill occurred offshore nearly due south of the Texas/Louisiana border, while Deepwater Horizon occurred nearly five years later offshore nearly due south of the Louisiana/Mississippi Border – over 300 miles away. Based on what is currently known about the two spills, and considering their temporal and spatial distance, NOAA was unable to quantify any overlapping impacts that would be relevant in measuring injury and scaling restoration for the DBL 152."

2. Requests for Further Monitoring – The Gulf Restoration Network and Ocean Conservancy (collectively the Non-Governmental Organizations or NGOs) and LOSCO commented that there should

be continued monitoring for environmental impacts from DB 152 oil because of the large amount of oil spilled and the relatively small amount recovered during response operations.

NOAA RESPONSE - Based on current information, it appears unlikely that additional monitoring would be justified at this point. This is due in part to the logistical difficulty and high cost associated with locating any possible remnants of the non-uniform and discontinuous submerged oil in such a large footprint (last estimated by the long-term monitoring efforts of the Unified Command to be approximately 45,000 acres). Because the DBL 152 oil was heavy, low viscosity oil, it sank quickly and is expected to have broken down into smaller and smaller particles rapidly. These small particles, in turn, have been weathering and collecting sediment at the bottom of the Gulf of Mexico for the last nine years. It is, therefore, highly unlikely that monitoring at this time would be able to identify oil or impacts that could be reliably "fingerprinted" to the DBL 152 oil spill. The slurry oil from this spill was a blended product difficult to characterize from the onset because of the wide range of residues and diluents used in its production. Thus, the benefits of such monitoring would be questionable.

Conversely, the costs of such monitoring would be substantial. Offshore monitoring of the Gulf floor would be extremely resource intensive under the best of circumstances. In this case, NOAA would be searching for oil that has not been observed for seven years, and that is predicted to have broken down considerably due to the physical characteristics discussed above. As to impacts, it is currently over four years past NOAA's predicted point of full recovery. Even if one assumes that (1) this prediction was incorrect and (2) injured resources had still not recovered in the intervening four years, it is likely that any lingering impacts would be so subtle that they could not reliably be attributed to the DBL 152. Finally, even if additional monitoring was justified, NOAA does not currently have the resources or funding to carry it out.

4. NOAA as the Sole Trustee – LOSCO disagreed that NOAA is the sole natural resource trustee for this incident and stated that Louisiana resources may also have been injured.

NOAA RESPONSE – NOAA's conclusion that it was acting as the sole trustee was based largely on the determination that injuries were limited to resources in federal waters. To date, NOAA has not found or been provided any quantifiable data that identifies injuries to Louisiana trust resources. As a practical matter, we anticipate that NOAA's planned claim to the National Pollution Funds Center will address only benthic injuries in federal waters. Therefore, NOAA's claim would not preclude the State of Louisiana from making a separate claim for any injuries it believes may have occurred to Louisiana resources.

5. Disagreement with the Proposed Project – Some commenters objected to NOAA's proposed action for reasons discussed below.

a. **Projects in Louisiana** – LOSCO proposed that NOAA select a project located in Louisiana.

NOAA RESPONSE – NOAA has no objection to considering a Louisiana project alternative for this incident and, accordingly, coordinated with LOSCO to identify a Louisiana candidate. LOSCO proposed the Oyster Bayou Marsh Creation project, located in the Calcasieu-Sabine Basin. This project is

described in more detail in Section 6 of the Final DARP/EA. NOAA concurs that this is a highly desirable project, and NOAA is, in fact, one of its sponsors. However, for reasons described in more detail in the Final DARP/EA, scaling incompatibilities and costs relative to the selected project make Oyster Bayou a less than ideal fit for this incident. Accordingly, NOAA has declined to select this project. However, given the project's merit, NOAA hopes to see this project implemented in the future.

b. **Marine Options** – The NGOs proposed that NOAA reconsider marine-based options. They specifically suggested that NOAA increase the capacity of marine mammal stranding networks or use pilot projects to evaluate the feasibility of offshore actions like the contaminated sediment capping project evaluated in the Draft DARP/EA.

NOAA RESPONSE – While NOAA agrees whole-heartedly with the concept of in-kind restoration, such actions are, unfortunately, not readily available or feasible in this case. Increasing the capacity of marine mammal stranding networks is laudable; however, there is little or no apparent nexus between this type of action and the injuries in this case. As noted in the Draft DARP/EA, NOAA did not identify any quantifiable injury to marine mammals.

Pilot projects evaluating offshore restoration are also problematic. As noted in the Draft DARP/EA, NOAA declined to propose the sediment capping project because of feasibility, scaling, and cost-effectiveness concerns. These concerns would not likely be resolved by undertaking pilot projects. In a pilot phase NOAA would still need to undertake the challenging and resource-intensive process of developing and scaling a novel restoration concept. Furthermore, much of the cost associated with offshore restoration is directly related to mobilization/demobilization and ship expenses. These costs would remain prohibitively high even if a project was undertaken as a pilot. Also, conducting pilots for already cost-prohibitive projects would prevent NOAA from achieving any economies of scale that would be available to a full scale project.

c. **Projects from Workshop List –** The Ocean Conservancy also provided a list of over 60 project options generated by a marine restoration workshop in 2012. NOAA applauds the development of broad-scale planning for the restoration of marine resources and sees great merit in many of the proposals contained on the NGOs' list. However, the projects included on this list were not necessarily appropriate as compensation for the DBL 152 incident. Given the number of projects on the list, they will be addressed here by category rather than individually.

> Wildlife and Fisheries Projects – Many of the priority projects in these categories are more akin to data gathering, monitoring, and research than the type of direct restoration of injured resources required by OPA. Others were additions or changes to existing regulations. While these concepts could potentially have a direct impact on fisheries and wildlife, implementation would be dependent on a complex regulatory amendment process, requiring public review and comment, that would likely unduly delay actual on-the-ground restoration. Ultimately, as noted below, NOAA did not identify any quantifiable injury to wildlife or fisheries; therefore, such projects would lack a nexus to the quantified injuries.

Human Use Projects – NOAA did not identify any lost human use requiring compensation; therefore, these projects would lack a nexus to the quantified injuries.

Ocean Habitat Projects – This category has the most significant nexus to the quantified injuries. However, like the wildlife and fisheries project lists, many of the top priorities in this category are research and/or regulatory proposals. The only direct, physical restoration project listed in the top five "Ocean Habitat" priorities is the establishment of oyster reefs – which is a component of NOAA's selected action.

6. Scale of the Estimated Injury – One commenter, the party responsible for the spill (the Responsible Party or RP), objected to NOAA's estimate of the scale of the injury and/or the restoration required to compensate for that injury.

a. Percent Service Loss – The RP objected to NOAA's estimate of ecological service losses.

NOAA RESPONSE - NOAA assigned 100% service loss to oiled areas within the cumulative oiled footprint. This was based on an estimated average thickness of oil across the 1% of seafloor oiled in the submerged oil field. This estimate, in turn, was based on several oil thickness measurements made in the field by divers where heavy and moderate oiling were observed.

Oil on the seafloor in sufficient quantities to form a film or layer of oil across the surface affects animals on and beneath the surface, fishes and other animals that may feed on seafloor organisms or occupy areas on or near the bottom, movement of benthic organisms, and other structural and functional ecological services. Oil was mobile, and offshore studies of deep seafloor ecological services over the entire submerged oil field would have been very difficult, prohibitively expensive, and scientifically challenging. Therefore, some estimation was required. Given that (as discussed above) the habitat covered in oil became effectively unusable, NOAA estimated 100% service loss. However, it is worth noting again that this estimate, at any given time, only applied to areas where oil was currently present, about 1% of the cumulative oil footprint. In other words, when the oil moved, the injury went with it.

b. Recovery Period – The RP objected to NOAA's estimate of the recovery period.

NOAA RESPONSE - NOAA estimated a three-year recovery period beginning after two years, the point at which the oil began to noticeably weather and dissipate. This results in a total injury period of five years from the spill until a return to pre-spill conditions. Literature from other spills document benthic recovery ranging from 6 to 20 years. More than 6 years after the Exxon Valdez oil spill occurred, differences in benthic amphipod community structure between oiled and reference sites still remained (Jewett et al., 1999). While observations from oil spills in Florida and the Amoco Cadiz spill suggest that benthic infaunal communities took between 1 (Saunders et al. 1980; Ibanez and Dauvin, 1988; Dauvin and Gentil , 1990) and 2 (Dauvin 1998) decades to fully recover to pre-spill conditions. Accordingly, the existing data and literature suggest that NOAA's recovery estimates were, if anything, quite conservative.

c. Marsh Conversion Factor - The RP objected to NOAA's method of converting injured offshore benthic habitat to nearshore benthic habitat for purposes of restoration scaling.

NOAA RESPONSE - In developing its relative habitat value (RHV) for offshore benthic and estuarine salt marsh habitats, NOAA gave precedence to secondary production (i.e., benthic invertebrates in this case) because that is where the injury occurred. As noted in the Draft DARP, NOAA focused its injury assessment solely on benthic invertebrates rather than also attempt to factor in injury to plants (i.e., primary productivity in this case) and higher level predators (i.e., tertiary productivity in this case). This is because offshore benthic habitat is characterized primarily by its secondary production. In other words, if you harm offshore benthic habitat, you are primarily harming benthic invertebrates. Furthermore, OPA directs trustees like NOAA to restore, replace, or acquire the equivalent of the injured resource. Therefore, if what is lost is secondary productivity, secondary productivity is what should be restored.

Nevertheless, NOAA recognized the value of nearshore habitat's higher primary production and applied the Peterson et al. (2007) marsh to subtidal benthic RHV of about 4.5:1. In the Baker and Arismendez (2011) memo, NOAA further determined that secondary production in offshore and nearshore benthic habitats is nearly identical. Thus, while the injury in question was to secondary production, NOAA gave significant "credit" for the restoration project's expected primary production as well.

Given the nature of the injury, NOAA could justifiably have looked only at secondary production for marsh, nearshore subtidal, and offshore subtidal habitat. Relying on the data cited by Peterson et al. (2007), this would have yielded an RHV of about .8:1 instead of 4.5:1, resulting in a restoration project 560 percent larger than the one proposed in the Draft DARP. Alternatively, NOAA could have opted for monumentally expensive and logistically challenging in-kind restoration of offshore benthic habitat. Rather than pursue either of these options, NOAA elected to take the more reasonable – and relatively generous – position of giving credit for primary production, even though the injury was to secondary production.

It is also worth noting that Peterson el al. (2007) present three options for developing RHVs, only one of which is to calculate the RVH at the trophic level where biogenic structural habitat is created (generally primary production). While the authors state that this method "may" be the most appropriate, they also posit two others: averaging productivity across the three lowest trophic levels and using sums of weighted production figures across all three trophic levels. In this case, the former would have resulted in a RHV of about 2.1:1 and the latter a RHV of about 1.2:1. Thus, of the three options presented by Peterson, the RP advocates for the method that is, by far, the most advantageous for the RP.

Finally, in discussing these three options, Peterson et al. (2007) caution against overemphasizing primary production, noting that unstructured habitats also have "relatively high habitat value" and that "compensatory restorations that involve substituting a structured habitat for an intertidal or shallow subtidal flat must include deductions for the lost services from the unstructured habitat area that disappears."

d. **Riprap Conversion Factor** – The RP objected to NOAA's method of valuing riprap for purposes of restoration scaling.

NOAA RESPONSE – The RP claims that NOAA should have valued benthic habitat to rip-rap at a ratio of 22.4:1 rather than 0.45:1. In essence, the argument goes that Reef Balls™ should be valued at 22.4:1,

and rip-rap is as productive as Reef Balls™; therefore, rip-rap should also be valued at 22.4:1. These points are dramatically misleading for a number of reasons.

The RP's argument assumes that Reef Balls are capable of providing up to 95% of the secondary trophic level production of natural oyster reef under ideal conditions. In turn, Peterson's 2007 analysis of relative habitat values suggests a potential 22.4:1 ratio of secondary production from natural oyster reef to subtidal benthic habitat. In other words, the 22.4:1 ratio was based on the very generous assumption that conditions at the restoration site would be ideal, and Reef Balls would be as productive as natural oyster reef.

During the cooperative assessment, restoration discussions focused on the use of Reef Balls™. However, after the RP backed away from the cooperative assessment process, NOAA revisited its restoration approach, and, for various reasons including relative costs and effectiveness of the two techniques, proposed the use of rip-rap instead of Reef Balls™. In that intervening period, NOAA was able to conduct a further analysis of the selected restoration project site and techniques and concluded that they support secondary production at a level far below 95% of a natural oyster reefs under ideal conditions. During that period, a significant amount of additional monitoring data was generated from a variety of breakwater installations in the Galveston Bay system using Reef Balls™ and rip-rap. This data shows secondary production on such structures to be so variable - and generally so much lower than that of natural oyster reef – that the application of the 22:1 ratio from Peterson's 2007 analysis is patently inappropriate.

NOAA has seen no evidence to support the RP's claim that project performance in prior phases of breakwater installation on the TCPNWRC shoreline showed "colonization by shellfish on concrete rip-rap … equal to (if not slightly greater than) colonization on Reef Balls™." This is not supported by monitoring performed on those prior breakwater installations. The NOAA Restoration Center (RC) funded prior phases of breakwater installation at the TCPNWRC shoreline through its Community-based Restoration Program partnership with Restore America's Estuaries (and its member organization, the Galveston Bay Foundation). Accordingly, NOAA RC assisted in the development of the project monitoring plan and received regular progress and monitoring reports from Galveston Bay Foundation. No quantitative comparison was performed to assess differences in shellfish colonization densities between rip-rap and Reef Ball™ substrates.

In summary, (1) there is no evidence to support the RP's claim regarding settlement densities on rip-rap from prior phases of breakwater construction; (2) secondary production performance of Reef Ball™ and rip-rap breakwater installations in the Galveston Bay system have generally been low, and (3) there is uncertainty relating to potential oyster colonization densities on the breakwater structure to be built under this DARP/EA. These factors, combined with the settled case history referenced in the DARP/EA all support the application of the 10:1 ratio for the relative production between marsh and rip-rap habitats documented in the Final DARP/EA.

e. **Increase in Required Restoration** – The RP objected to the amount of required restoration in the Draft DARP/EA.

NOAA RESPONSE – The RP is correct that the compensatory restoration requirement increased primarily because of the larger injury debit and reduced relative habitat value for breakwater. The reasons for these changes are discussed in great detail above.

The RP is also correct that the breakwater footprint increased because of the change in proposed construction techniques from Reef Balls™ to rip-rap. NOAA proposes a 17.5-foot bottom width based on successful design specifications from prior phases of breakwater installation on the TCPNWRC shoreline. The wider footprint achieves a stable structure with a three-foot crest elevation above the bay bottom, as stated in the DARP/EA.

7. NOAA's Explanation of Fish/Wildlife Injuries – The Ocean Conservancy commented that NOAA insufficiently explained the nature and extent of fish and wildlife injuries in the Draft DARP/EA.

NOAA RESPONSE – Upon further review, we concur that the description of potential fish and wildlife injuries was not a model of clarity, and we appreciate the Ocean Conservancy bringing this to our attention. The Draft DARP/EA states as follows:

> "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."

To clarify, NOAA did not observe or identify specific, measurable impacts to water column species. As stated in Section 3,

> "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."

The prior statement was intended to communicate that, while NOAA did not identify specific wildlife injuries, it is likely that water column species experienced some subtle impacts that were not readily measurable (e.g., it is difficult to measure the impacts of fish avoiding or failing to find prey in a particular segment of oiled seafloor habitat). While NOAA could not quantify these impacts, what NOAA could quantify is the injury to that seafloor habitat and the benthos that occupy it. Thus, the habitat injury served as a proxy and was used to scale appropriate habitat restoration.

NOAA has added clarifying language to these two paragraphs in the Final DARP/EA.

8. NOAA's Proposed Use of Riprap for Restoration – The NGOs objected to the proposed used of riprap for restoration rather than Reef Balls.

NOAA RESPONSE – As described in Section 6.1.1 of the Final DARP/EA, rip-rap was proposed as the breakwater construction material based on the stated preference of the staff at TCPNWRC, the project site owner and project implementation partner. TCPNWRC staff consider rip-rap to be the more effective material for the project's primary goal of erosion control. This is based on their experience in prior phases of breakwater construction on the TCPNWRC shoreline. NOAA recognizes the potential that this technique may provide lower secondary production per acre of breakwater constructed and has adjusted the project scale accordingly to ensure that compensatory requirements are met.

APPENDIX C. PUBLIC COMMENTS

This appendix contains the full text of the public comments received by NOAA during the public comment period.

PUBLIC SUBMISSION

As of: March 22, 2013
Received: March 21, 2013
Status: Pending_Post
Tracking No. 1jx-84bt-w3kp
Comments Due: April 15, 2013
Submission Type: Web

Docket: NOAA-NMFS-2013-0034
Draft Damage Assessment and Restoration Plan/Environmental Assessment for the Tank Barge DBL 152 Oil Spill

Comment On: NOAA-NMFS-2013-0034-0001
Draft Damage Assessment and Restoration Plan/Environmental Assessment

Document: NOAA-NMFS-2013-0034-DRAFT-0002
Comment from Robert Brassell, Jr., N.Y.S.N.P.

Submitter Information

Name: Robert James Brassell, Jr., N.Y.S.N.P.
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New York, NY, 10116-8916
Email: Hu7138e4i1@aol.com
Organization: Delois Albert Brassell Estate (active CAGE Code 5PAZ8)

General Comment

Speaking and acting within ALL, ALL INCLUSIVE, my capacities, ALL INCLUSIVE, INCLUDING AND ESPECIALLY as the respective SOLE, PRO BONO Administrator of the Delois Albert Brassell Estate (D-U-N-S Number 831823948, active CAGE Code 5PAZ8), Robert James Brassell Estate (D-U-N-S Number 962019514, active CAGE Code 64WJ9), Annie Bell/Belle Albert Estate (United States EIN 27-6382218), Trudie Brassell Estate (United States EIN 90-6214502), Len Albert Estate (United States EIN 35-6822992), Charles Dennis Bronson Estate (United States EIN 46-6603164), George Albert Estate (United States EIN 35-6822993), Walter Francis McCarthy Estate (United States EIN 46-6128556), Robert Brassell Sr. Estate (United States EIN 32-6241103), John Aikman Estate (United States EIN 46-6229304), Dorothy M. Aikman Estate (United States EIN 46-6229582), Annie May Brassell Estate (United States EIN 45-7027079), Vernell Albert Estate (United States EIN 35-6822994), Julius Blackshear Estate (United States EIN 30-6337223), Arthur F. Rothschild Estate (United States EIN 46-6553791), Mary Moroney Estate (United States EIN 46-6579890), Veronica M. Moroney Estate (United States EIN 46-6576898), Melvin Blaine Rothschild Estate (United States EIN 46-6549605), Robert C. Rothschild Estate (United States EIN 46-6551214), Gustave Robert Rothschild Estate (United States EIN 46-6557440), Elisabeth Maria Rothschild Estate (United States EIN 46-6590684), Mary Moroney Sr. Estate (United States EIN 46-6582955), Jane Aikman Carbis Estate (United States EIN 46-6597056), Lois Washington Cobb Estate (United States EIN 38-7056893), Herbert Hirsh Rothschild, Jr., Estate (United States EIN 46-6600121), Michael Joseph Jackson Estate (United States EIN 46-6160053), Thomas J. Moroney Estate (United States EIN

27-6382172) and Alfred William Schrammar Estate (United States EIN 46-6594472), ALL INCLUSIVE: We carefully favor, support and approve the "draft plan/assessment" (i.e, NOAA-NMFS-2013-0034-0001). Thank you.

Department of Public Safety and Corrections
Public Safety Services

BOBBY JINDAL
GOVERNOR

MICHAEL D. EDMONSON, COLONEL
DEPUTY SECRETARY, PUBLIC SAFETY SERVICES
SUPERINTENDENT, OFFICE OF STATE POLICE

April 15, 2013

VIA FAX

Chris Plaisted
NOAA/GCNR
501 W. Ocean Blvd.
Suite 4470
Long Beach, CA 90802

Re: Draft DARP/EA for Tank Barge DBL 152 Oil Spill

Dear Mr. Plaisted:

Louisiana's Natural Resource Trustees appreciate the opportunity to submit comments on the Draft Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA) for the Tank Barge DBL 152 Oil Spill (DBL 152 Incident). As you know, Louisiana's Natural Resource Trustees are the Louisiana Coastal Protection and Restoration Authority, Louisiana Oil Spill Coordinator's Office, Louisiana Department of Wildlife and Fisheries, Louisiana Department of Environmental Quality and the Louisiana Department of Natural Resources (Louisiana Trustees). The Louisiana Trustees work closely with the National Oceanic and Atmospheric Administration (NOAA) in responding to oil spills and conducting natural resource damage assessments for spills that impact Louisiana's unique and diverse natural resources.

We respectfully submit the following comments to the DBL 152 Incident DARP/EA:

Overlap with Deepwater Horizon Oil Spill

Since April of 2010, the Louisiana Trustees and NOAA (as well as several other state and federal natural resource trustees) have been working together in responding to and conducting a natural resource damage assessment (NRDA) for the Deepwater Horizon Oil Spill. In the DBL 152 Incident DARP/EA, NOAA states that while it considered the impacts of the Deepwater Horizon Oil Spill on the environment affected by the DBL 152 Incident, "NOAA concluded that there were likely few, if any, overlapping impacts between the two spills." The Deepwater Horizon Oil Spill is unprecedented in its scope and scale, including its duration, spatial extent, volume of oil spilled, and volume of oil still remaining in the environment. The NRDA for the

Deepwater Horizon Oil Spill is ongoing and may be ongoing for many years to come. Any conclusory statement by NOAA that limits potential overlapping impacts from these two spills is premature.

Longer-term Monitoring of Lingering Oil and Impacts

NOAA estimates in the DBL 152 Incident DARP/EA that "43, 491 bbls (1,826,622 gallons) of oil remained unrecovered at the time submerged oil cleanup operations were discontinued in January 2006." That is, only a tiny fraction of the discharged oil was ever recovered, with almost 2 million gallons of oil left in the environment to continue interacting with and impacting natural resources. This unrecovered oil can create lingering and chronic adverse effects to those resources, which can in turn adversely affect the broader ecological system of the continental shelf of the northwestern Gulf of Mexico. The Louisiana Trustees would like to discuss with NOAA how to monitor the presence, amount, fate and any possible environmental impacts of oil from the DBL 152 Incident to the broader ecosystem, and if lingering oil is detected, how to remove it.

NOAA as Sole Trustee

NOAA states in the DBL 152 Incident DARP/EA that it is "the sole natural resource trustee for this Incident." The Louisiana Trustees do not agree with this statement; rather, NOAA is the primary trustee coordinating the cooperative NRDA for the DBL 152 Incident. It seems that NOAA reaches its conclusion that it is the sole trustee based on its findings in the DARP/EA that the DBL 152 Incident occurred in Federal waters, based on NOAA's finding that no wildlife impacts were observed, and because to date, information on exposure to mobile organisms has been characterized by NOAA as "short-term" and "of low magnitude". However, as mentioned above, the affected environment and any resources that may continue to be exposed to lingering oil are part of a broader ecological system, which may include resources over which the Louisiana Trustees share cotrusteeship with NOAA.

Consultation with and Consideration of Restoration Alternatives in Louisiana

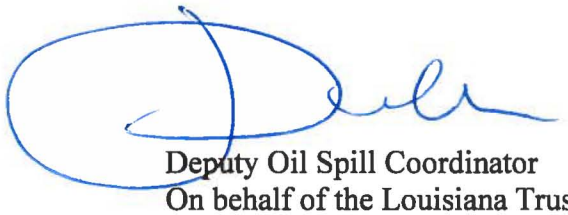
During the offshore response to the DBL 152 Incident, NOAA periodically provided information to Louisiana Trustee representatives of Incident progress. However, the Louisiana Trustees were unaware that NOAA was drafting the DBL 152 Incident DARP/EA and were unaware that NOAA was only considering 7 restoration alternatives in the offshore environment and in Texas, from Galveston Bay to Sabine Lake. Both the capsize and the allision location for the DBL 152 Incident happened east of the Texas border, south of Louisiana. The current affected environment, based on information collected to date, as depicted graphically throughout the DBL 152 Incident DARP/EA, is likewise south of Louisiana and east of the Texas border. The Louisiana Trustees respectfully request that NOAA consider restoration alternatives in Louisiana that likewise meet evaluation criteria set forth in the Oil Pollution Act, and that have a stronger geographic nexus to the injured area than the restoration alternatives currently under consideration by NOAA.

The Louisiana Trustees agree with NOAA's statement in the DBL 152 Incident DARP/EA that the affected environment is part of a larger ecological system, and that

appropriate restoration opportunities within that system include inshore estuarine areas that provide nursery habitat for many species inhabiting the continental shelf. The Louisiana Trustees also agree with NOAA's statement in the DARP/EA that shoreline protection and marsh creation projects have successfully provided improved ecological services in a cost effective manner in the past. NOAA should consider projects in Louisiana that have a similar ecological nexus to the injured habitat, but that may be farther along in engineering and design than the "preliminary design concept" of the preferred restoration alternative. This may allow NOAA to achieve restoration of the affected environment faster.

The Louisiana Trustees appreciate NOAA's consideration of these comments.

Sincerely,



Deputy Oil Spill Coordinator
On behalf of the Louisiana Trustees

SHIPMAN & GOODWIN LLP®
COUNSELORS AT LAW

Andrew N. Davis
Phone: (860) 251-5839
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April 15, 2013

VIA FACSIMILE (562-980-4065) AND E-FILING

National Oceanic and Atmospheric Administration
U.S. Department of Commerce
Office of General Counsel
Natural Resources Section
Attn: Christopher J. Plaisted, Esq.
501 West Ocean Blvd., Suite 4470
Long Beach, CA 90802

Re: Comments on the Draft Damage Assessment and Restoration Plan/Environmental Assessment for the Tank Barge DBL 152 Oil Spill (Docket I.D.: NOAA-NMFS-2013-0034)

Dear Chris:

On behalf of the West of England Ship Owners Mutual Insurance Association (Luxembourg) S.A. (the "Club"), a member of the International Group of P&I Clubs, please find attached comments on the Draft Damage Assessment and Restoration Plan/Environmental Assessment for the Tank Barge DBL 152 Oil Spill (Docket I.D.: NOAA-NMFS-2013-0034), prepared on behalf of the Club by Cardno ENTRIX.

We most appreciate your cooperation and courtesies in this matter.

Very truly yours,

Andrew N. Davis

Enclosure
cc: Tony Paulson, West of England Ship Owners Mutual Insurance Association (Luxembourg) S.A.
Austin P. Olney, Holland & Knight LLP

2764924v1

Cardno ENTRIX
Shaping the Future

Memorandum

Date: April 15, 2013

To: Andrew N. Davis, Ph.D., Shipman & Goodwin LLP
Austin P. Olney, Holland & Knight LLP

From: Ralph Markarian, Ph.D., Chris Pfeifer & John Gordon

RE: **Comments on the Draft Damage Assessment and Restoration Plan/Environmental Assessment for the Tank Barge DBL 152 Oil Spill**

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1.0 Overview

The Tank Barge DBL 152 Oil Spill took place in federal waters of the Gulf of Mexico beginning on November 11, 2005. In January 2007, the Responsible Party (RP), K-Sea Transportation Partners LP, formally accepted an invitation from the National Oceanic and Atmospheric Administration (NOAA), the sole Trustee for this incident, to participate in a cooperative natural resource damage assessment (NRDA) process under the Oil Pollution Act of 1990 (OPA 90). In May 2009, the U.S. Coast Guard National Pollution Funds Center (NPFC) determined that the RP qualified for a limitation of liability under OPA 90, and had already exceeded the applicable limit of liability. Accordingly, the RP no longer has a direct interest in this matter. However, the RP's indemnity insurer, The West of England Ship Owners Mutual Insurance Association (Luxembourg) S.A. (the Club), a member of the International Group of P & I Clubs, has asked Cardno ENTRIX to review the Draft Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA) for this spill prepared by NOAA (dated March, 2013) and provide comments on behalf of the Club. Prior to May 2009, Cardno ENTRIX participated in the cooperative NRDA process and related injury assessment and restoration planning discussions with NOAA on behalf of the RP and the Club. Our comments address some unsupported technical conclusions that could significantly affect future NRDAs under OPA 90.

It appears that certain methods and analyses undertaken by NOAA fail to rise to an appropriate level of technical rigor, economic efficiency, and reasonableness required by the OPA regulations. Based on our analysis, we find that:

- The Draft DARP/EA identifies an inflated level of alleged natural resource injury and compensatory restoration required to offset that injury relative to service losses and gains calculated using scientifically-defensible scaling inputs and assumptions;
- Both the interim ecological service loss and scale of compensatory restoration specified in the Draft DARP/EA (and ultimately its cost) are significantly greater than the corresponding injury level and compensatory restoration requirement set forth in

NOAA's habitat equivalency analysis (HEA) developed during cooperative NRDA discussions; and

- The basis for the amount of restoration proposed in the DARP/EA embodies significant deficiencies and errors in the application of assessment tools, misinterpretations of the literature, and/or an absence of the appropriate degree of scientific rigor, all of which will significantly increase the cost of the final restoration that, in the absence of an ongoing RP, will be funded by the Oil Spill Liability Trust Fund for this matter, and may have significant implications for the scope and cost of future NRDAs.

We recognize that the NRDA process inherently involves uncertainties and understand that it may be reasonable in some circumstances to make simplifying assumptions and use expedited approaches in order to provide best professional judgment in the absence of field data. Such an approach, judiciously applied, can avoid transaction costs that exceed the value of added precision afforded by additional studies. However, even simplified, expedited approaches must meet certain standards of rigor in design and application, and result in reasonable injury calculations and appropriate scaling parameters so that the restoration compensates for actual injuries.

2.0 Injury Debit

During the cooperative NRDA process, NOAA and the RP agreed to use HEA to quantify injury and scale compensatory restoration. As expressed during the cooperative NRDA process, the RP was willing to accept, for purposes of settlement only, NOAA's calculated debit of 1,086 offshore mud bottom discounted service acre years (DSAYs), even though this figure was, in the RP's judgment, 3-5 times greater than what was supported by information derived from the long-term monitoring efforts conducted during the spill response, and other applicable scientific information. NOAA's initial debit of 1,086 DSAYs was based on several conservative assumptions including:

- An initial loss of one hundred percent (100%) of all ecological services provided by affected offshore mud bottom habitat followed by immediate initiation of recovery, even though our review indicated that a complete loss of all services was unrealistic and that an initial service loss of 75 percent would conservatively address uncertainties; and
- A 5-year recovery period for injured ecosystem services to return to baseline, even though relevant scientific data, literature-supported analyses, life-history characteristics of potentially affected biota, and other environmental factors support a recovery time of between 8 months and 2.5 years.

However, in the Draft DARP/EA, NOAA has increased the debit from 1,086 to 1,475 offshore mud bottom DSAYs. Although we were not able to recreate NOAA's HEA exactly based on the information provided in the Draft DARP/EA, we believe the increase in debit is driven by an assumption that the spill resulted in the complete (100%) loss of offshore mud bottom services for a prolonged period lasting 1-2 years before recovery was initiated. This is contrary to NOAA's assumption during the cooperative assessment that recovery of injured ecological services began immediately post-spill. We strongly disagree with NOAA's decision to increase the debit and extend the period before ecosystem recovery was initiated because these assumptions represent an even greater departure from what is even most conservatively supportable by applicable scientific information (Armstrong *et al.* 1995, Kingston *et al.* 1995, Feder and Blanchard 1998, Serrano *et al.* 2006).

3.0 Restoration Scaling

NOAA's proposed compensatory shoreline project is "out-of-kind" restoration because the habitat being restored (estuarine salt marsh) is different than the potentially injured habitat (offshore mud bottom). To properly scale out-of-kind restoration, it is necessary to establish a ratio of relative habitat value (RHV) to make the injured and restored habitats comparable. For this case, NOAA adopted the approach of Peterson *et al.* (2007) who establish RHVs based on biological productivity of selected nearshore estuarine habitats. However, Peterson *et al.* (2007) do not provide productivity values for the habitat type allegedly injured by the DBL 152 (*i.e.* offshore mud bottom located 30+ nautical miles offshore in the Gulf of Mexico on the continental shelf at a depth of 50-60 feet). Instead, NOAA used values reported by Peterson *et al.* (2007) for habitat classified as "shallow subtidal flat" (mudflats at 0-10 ft. depth) as a surrogate for offshore mud bottom habitat.

Peterson *et al.* (2007) advocate calculating RHVs at the trophic level at which biogenic structural habitat is created in an effort to reflect food production as well as habitat provision. In computing the RHV between estuarine salt marsh and shallow subtidal flat, Peterson *et al.* (2007) compare primary production between the two habitats to determine that 1 acre of marsh is equivalent to 4.1-5.1 acres of shallow subtidal flat. Primary production was selected as the basis for this RHV comparison because it is the trophic level at which biogenic structural habitat is provided in salt marsh (*i.e.* above-ground plant stems). The Draft DARP/EA assumes that 1 DSAY of created or protected marsh is equivalent to 4.5 DSAYs of offshore mud bottom. This assumption fails to account for differences in productivity between shallow subtidal flat and offshore mud bottom. Thus, the NOAA ratio of 4.5:1 is inconsistent with the theory and methods employed in Peterson *et al.* (2007).

We disagree with NOAA's use of shallow subtidal flat as a surrogate for offshore mud bottom because it fails to account for the substantially reduced productivity of benthic substrate in deeper offshore waters relative to shallow subtidal flats. The unjustifiable assumption that nearshore and offshore sediments have equal productivity leads to a significant overestimate of the amount of compensatory restoration required to offset the injury.

The inverse relationship between benthic productivity and water depth is well documented in the peer-reviewed scientific literature (Rowe *et al.* 1974, Galloway *et al.* 1988, Cruz-Kaegi and Rowe 1992, Escobar-Briones and Soto 1997, Rowe *et al.* 2002, Palmer *et al.* 2008, and Rowe *et al.* 2008). In fact, during the cooperative NRDA process, both NOAA and the RP conducted literature reviews to assess whether shallow subtidal flat was an appropriate substitute for the potentially injured offshore mud bottom habitat. This issue remained unresolved in May 2009 when the RP qualified for limitation under OPA 90.

NOAA subsequently attempted to justify the use of the 4.5:1 RHV for marsh to offshore mud bottom by considering only secondary productivity and excluding primary productivity (Baker and Arismendez 2008). We disagree with the practice of using secondary productivity alone because such an approach is inconsistent with NOAA's preferred methods as articulated in Peterson *et al.* (2007). Peterson *et al.* (2007) based their RHVs for comparisons involving estuarine salt marsh on primary productivity in an effort to capture the value of the structured habitat provided by marsh vegetation. Because primary production in marsh habitat contributes to a variety of ecological services beyond food web support, and since benthic primary production is negligible in offshore habitats, it is clear that estuarine marsh habitat is many times more valuable than offshore mud bottom.

Notwithstanding our objection to the use of secondary productivity for the RHV, we also question the accuracy of secondary productivity calculations used by NOAA to justify its RHV (Baker and Arismendez 2008). NOAA calculated a secondary productivity value for marsh habitat from data available in Whaley and Minello (2002), and indicated that the methods described in Peterson *et al.* (2007) were used to estimate a benthic macrofaunal productivity of 15.03 g C m^{-2} yr^{-1}. However, Peterson *et al.* (2007) provided their own estimate of secondary productivity from the Whaley and Minello (2002) data equal to 48.7 g C m^{-2} yr^{-1}. NOAA has provided no explanation for the difference between its calculated value of productivity, and the value provided in Peterson *et al.* (2007). The consequence of this discrepancy is the devaluing of marsh habitat (the habitat to be restored) by a factor of 3.24 in terms of secondary productivity. This leads to a significant overestimate of compensatory restoration requirements.

Peterson *et al.* (2007) also suggest that RHVs may be calculated from the sum of primary and secondary productivity for each habitat. This method ensures that the full range of ecological services provided by each habitat is captured. It also serves as a reasonable compromise in the debate of whether to use primary or secondary productivity to calculate RHVs. It appears that NOAA did not take these factors into consideration and thus severely overestimated the amount of restoration needed. If this method is used, the combined primary and secondary productivity of estuarine salt marsh is, at a minimum, 12.6 times greater than the productivity of offshore mud bottom habitat.

NOAA also developed a RHV comparing concrete rip-rap habitat to offshore mud bottom to compute offset credit for the breakwater component of the proposed shoreline restoration project. Rather than basing its RHV on a productivity ratio, NOAA referenced previous cases, including the M/T Athos I (DE, NJ, & PA Natural Resource Trustees, 2009) and the M/V Westchester (LOSCO, 2001). In these cases, NOAA assumed that rip-rap habitat possessed one-tenth the value of estuarine salt marsh habitat. NOAA acknowledges that this ratio was not based on extensive literature review, and is likely very conservative. For the present case, NOAA used this 10 percent ratio to calculate a RHV for concrete rip-rap to offshore mud bottom by multiplying its RHV for salt marsh to offshore mud bottom (4.5:1) by 10 percent (4.5 * 0.10 = 0.45). The resulting RHV (0.45:1) reflects NOAA's assertion that rip-rap is 10 percent as valuable as estuarine salt marsh. We do not agree with this basis for a RHV for concrete rip-rap restoration to offshore mud bottom because:

- A project at Anahuac National Wildlife Refuge (NWR) implemented by the U.S. Fish and Wildlife Service demonstrated that colonization by shellfish on concrete rip-rap appeared equal to (if not slightly greater than) colonization on Reef Balls™. NOAA previously indicated in cooperative discussions on this case that a 22.4:1 scaling ratio would be appropriate for Reef Balls™ (NOAA Preliminary HEA, 2008). The effect is that in this Draft DARP/EA, NOAA has devalued the restoration credit of the breakwater by approximately 98 percent compared to NOAA's previously developed values; and
- As discussed above, we do not agree with NOAA's suggested RHV for marsh to offshore mud bottom habitat (4.5:1). If NOAA's assumption that concrete rip-rap is 10 percent as valuable as marsh is to be adopted, it should at least be based upon a more accurate RHV for marsh to offshore mud bottom.

4.0 Compensatory Restoration Required

During cooperative NRDA discussions with the RP prior to May 2009, NOAA proposed a shoreline protection/restoration project in Anahuac NWR along East Galveston Bay as compensatory restoration for potentially lost ecological services. NOAA's proposed project entailed constructing a shore-parallel

breakwater 20-25 feet offshore using Reef Balls™ and planting *Spartina alterniflora* marsh grass between the breakwater and the existing shoreline. Based on NOAA's characterization, the project would create new oyster reef habitat and salt marsh habitat, as well as preserve existing salt marsh by preventing further erosional losses. Using HEA to scale the amount of restoration, NOAA determined that 1.85 miles of such a project would be needed as compensatory restoration to offset its calculated debit of 1,086 offshore mud bottom DSAYs (NOAA Preliminary HEA 2008).

Based on the restoration scaling described in the Draft DARP/EA, NOAA states that a minimum of 4.23 miles of shoreline protection/restoration are needed to adequately compensate the public for injuries arising from the DBL 152 Incident. This amount of compensatory restoration is a significant increase over the 1.85 miles of shoreline protection/restoration NOAA originally proposed during cooperative NRDA discussions with the RP, despite few substantive changes in the proposed restoration project. Included within this expansion is an increase in the amount of breakwater habitat per linear mile from 0.84 acres/mile to 2.12 acres/mile. Thus, the total acreage of breakwater to be installed for compensatory restoration has increased from 1.55 acres to 8.97 acres, a nearly 6-fold increase over what NOAA previously proposed for this project component during cooperative discussions with the RP.

We were able to determine that the increase in the length/acreage of the restoration project was largely due to issues that have already been discussed in our comments above, such as the increase in the calculated injury debit from 1,086 to 1,475 DSAYs, and the reduction in the RHV for rip-rap breakwater to offshore mud bottom from 22.4:1 to 0.45:1. However, it is unclear why NOAA significantly increased the acreage of rip-rap habitat per mile from 0.84 acres/mile to 2.12 acres/mile. We believe this increase reflects a shift in the restoration design to wider or alternately configured breakwaters, but it is unclear why NOAA feels that such design changes are necessary. It is also unclear why NOAA chose to devalue the ecological services of the breakwater component compared to the HEA scaling assumptions used during the cooperative NRDA process.

During cooperative NRDA discussions, the RP proposed to fund construction of 0.80 miles of the shoreline protection/restoration project proposed by NOAA. Of this amount, 0.53 miles was intended to compensate for potential injury to offshore mud bottom, and an additional 50 percent (0.27 miles) was added to address potential injury to water column. This proposal incorporated NOAA's originally proposed injury debit of 1,086 mud bottom DSAYs, as well as our conservative arguments expressed above. We are confident that 0.80 miles of shoreline protection/restoration adequately compensates for all potential injury while remaining conservative and favorable to the public.

5.0 Summary

We appreciate the opportunity to comment on the Draft DARP/EA associated with the Tank Barge DBL 152 Oil Spill. We identified several technical issues associated with methods, assumptions, and parameters in the Draft DARP/EA used by NOAA to quantify injury and scale restoration that we believe result in a substantial overestimate of the amount of restoration necessary to compensate for potential injury caused by the Tank Barge DBL 152 Oil Spill including:

- Offshore mud bottom services were assumed to be reduced by one hundred percent (100%) for 1-2 years, instead of assuming recovery began immediately post-injury as was done during cooperative NRDA discussions. This results in an increase of the injury debit from 1,086 to 1,475 offshore mud bottom DSAYs;

- Peterson *et al.*'s (2007) RHV comparing estuarine salt marsh to shallow subtidal flat was adopted by NOAA to scale compensatory salt marsh habitat to potentially injured offshore mud bottom habitat without adjustment for productivity differences, despite an inverse relationship between benthic productivity and depth that is well-established in the literature;
- The use of a 0.45:1 RHV to scale compensatory rip-rap breakwater habitat to potentially injured offshore mud bottom habitat despite results from a U.S. Fish and Wildlife Service demonstration project at Anahuac NWR indicating concrete rip-rap supported at least as much secondary production as Reef Balls™, for which NOAA previously applied a 22.4:1 RHV during cooperative NRDA discussions; and
- NOAA increased the amount of breakwater to be installed to 2.12 acres/mile despite previously proposing a restoration design where 0.84 acres/mile was sufficient and without offering a scientific rationale for such an increase.

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April 15, 2013

Chris Plaisted
NOAA, Office of General Counsel
Natural Resources Section
501 W. Ocean Blvd, Suite 4470
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Subject: Gulf Restoration Comments on Draft DARP for Tank Barge DBL 152 oil spill

Dear Mr. Plaisted:

On behalf of the Gulf Restoration Network (GRN) I submit these comments on the draft damage assessment and restoration plan (DARP) prepared for the 2005 Tank Barge *DBL 152* oil spill. The GRN is an 18 year old nonprofit advocacy group committed to uniting people to protect the natural recourses of the Gulf of Mexico. We recognize the challenges associated with conducting oil spill natural resource damage assessments (NRDA) and restoration in the offshore environment, and the Tank Barge *DBL 152* oil spill is no exception.

The GRN has serious concern with NOAA's preferred alternative. Initially, we do not believe that the focus on wetlands restoration and protection is appropriate, as the incident and attendant damage and loss of services occurred 35 miles from the proposed project site. We join with the Ocean Conservancy in recommending that NOAA withdraw the preferred alternative and reevaluate the suite of alternatives. Marine restoration options must be considered that have a stronger nexus to the injuries and lost services. Additionally, NOAA should continue long-term monitoring the impact of the *DBL 152* oil spill. Finally, should NOAA proceed with the current preferred alternative, we believe the shoreline protection component is problematic and, at a minimum, NOAA should replace the rip rap option with an ecologically preferable oyster reef.

Further Consideration of Marine Restoration Options Needed

We request that NOAA suspend its current course of action and reevaluate the alternative to consider other marine restoration options available to the agency. For example, increasing the capacity of marine mammal stranding networks along coastal Texas and Louisiana to improve rescue and rehabilitation success is a form of compensatory restoration that could speed the recovery of any bottlenose dolphin populations injured by the Tank Barge *DBL 152* oil spill. (An Unusual Mortality Event is still occurring in the northern Gulf and one occurred as recently as 2012 in northern Texas.)

NOAA also should consider small-scale pilot projects (as allowed under NRDA) to explore the feasibility of alternatives with a stronger marine nexus before a decision to scale up. For

example, NOAA considered but rejected the alternative to cap contaminated sediments beneath offshore platform production because of expense, potential environmental impacts and unproven techniques. However, NOAA could propose and proceed with a pilot study at one site (platform), thereby limiting cost and the risk of secondary impacts (e.g., sedimentation of hard bottom habitats in Flower Garden Banks NMS) from the action.

Long-term Monitoring of Lingering Oil and Impacts

NOAA monitored the movement and fate of the oil for the first two years after the incident, but discontinued '"long-term monitoring" when efforts to recover oil ended. The DARP says that only a fraction (~5 percent) of the discharged oil was recovered. We know from other marine oil spills that lingering oil can expose or reexpose organisms, resulting in harmful, chronic impacts in animals and impacting ecological interactions (e.g., food web). Storms, currents, trawling and other factors can lead to resuspension or movement of oil that puts marine species and sensitive coastal and marine habitats at risk. The *Exxon Valdez* Oil Spill Trustee Council continues to fund residual oil monitoring more than 20 years after that event. As a result, we believe that NOAA should continue to monitor the presence, amount, fate and environmental impacts of oil from the Tank Barge *DBL 152* oil spill for a minimum of 10 years.

Changes to the Preferred Alternative Needed

We continue to believe that NOAA's preferred alternative to compensate the public for injured offshore benthic resources and lost productivity lacks a sufficient nexus to the injury. However, should NOAA choose to proceed with the preferred salt marsh and shoreline protection alternatives, we recommend that NOAA adopt the changes to the preferred alternative offered by the Ocean Conservancy, namely

> The shoreline protection component would be accomplished through the addition of a rip rap breakwater. We have some concerns about the use of rip rap, and we recommend that NOAA replace the rip rap breakwater with an oyster reef to accomplish the goal of protecting Spartina marsh and producing productivity similar to that which was lost in the injured offshore benthic environment. A living shoreline comprised of natural oyster reef has ecological and practical advantages over rip rap.
>
> Rip rap represents an unnatural substrate in estuaries where soft sediments dominate. If rip rap is to be deployed in a parallel orientation to the shoreline, the structure may lead to erosion of the marsh landward of the rip rap revetment. Parallel orientation can interfere with estuarine ecological processes by reducing the connectivity between the marsh behind the revetment and waters on the estuarine side of the artificial structure. Consequently, fishes and crustaceans may lose some ability to move in and out of the high marsh behind the revetment, affecting their use of this important nursery habitat. The erosion of marsh resulting from the rip rap is likely to exacerbate the effects of sea level rise, a serious concern in the area, and thus would decrease coastal resiliency.

. . . an oyster reef is ecologically preferable to a rip rap breakwater, potentially resulting in a higher and more sustained environmental and human use return for the investment. East Galveston Bay, the proposed siting of the preferred alternative, has a long history of productive oyster reefs, which are now greatly depleted. While rip rap can support oyster colonization and growth, oyster reef breakwaters generally grow more oysters than do rip rap. As sea level rises, oyster reefs are capable of upward growth and self-renewal, thus providing an advantage over rip rap in terms of resilience. Oyster reefs are vulnerable to storms, but if rendered non-functional by storm damage, the reefs would bioerode more effectively than rip rap and pose less of a hazard. As sea level rises, rip rap could pose a nuisance or hazard to people accessing estuarine waters. The oyster reefs provide essential fish habitat for finfish sought by anglers, and could day one support a sustainable directed fishery. Moreover, oyster filtration benefits the estuary and estuarine organisms by improving water quality. This use of restored oyster reef would follow the guidance of marine resource and restoration experts in the Gulf of Mexico.

Summary

As discussed, we feel it would be appropriate for NOAA to replace the preferred alternative with marine restoration options that better match the injuries and lost services documented in the offshore environment. The report attached to the comments submitted by the Ocean Conservancy provides a menu of compensatory restoration strategies for injuries to marine resources. We recommend that NOAA consult that report to better match marine restoration alternatives with injuries to demersal or pelagic fishes or marine mammals resulting from the *DBL 152* oil spill.

If NOAA proceeds with the preferred alternative, we recommend NOAA substitute an oyster reef (living shoreline) for the proposed rip rap breakwater because we believe the ecological services would be greater and liabilities lower if an oyster reef were selected as the preferred alternative for protecting the shoreline. Finally, we recommend NOAA commit to undertaking/funding long-term monitoring of the remaining oil, particularly its fate and environmental impacts, and the status and recovery of natural resources.

Please do not hesitate to contact me at 504-525-1528 ext 202 if you have questions or need additional information.

Sincerely,

Cynthia M. Sarthou
Executive Director

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April 12, 2013

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Subject: Ocean Conservancy Comments on Draft DARP for Tank Barge DBL 152 oil spill

Dear Mr. Plaisted:

Ocean Conservancy[1] appreciates the opportunity to submit comments on the draft damage assessment and restoration plan (DARP) prepared for the 2005 Tank Barge *DBL 152* oil spill. We recognize the challenges associated with conducting oil spill natural resource damage assessments (NRDA) and restoration in the offshore environment, and the Tank Barge *DBL 152* oil spill is no exception.

We believe, however, that the preferred alternative, with a focus on wetlands restoration and protection, is not appropriate and would not sufficiently make the public or environment whole because the oil spill, and injuries and lost services that resulted, occurred approximately 35 miles from the proposed project site. Therefore, we recommend that NOAA withdraw the preferred alternative and reevaluate the suite of alternatives. Additional marine restoration options must be considered, including continuation of long-term monitoring, that have a stronger nexus to the injuries and lost services. We have attached a workshop report as a resource for your consideration of marine restoration options to replace the current preferred alternative. We also are concerned that there were missteps during injury quantification that—had they been avoided—could have resulted in a stronger scientific basis for marine restoration. Finally, should NOAA proceed with the current preferred alternative, we believe the shoreline protection component is problematic and, at a minimum, NOAA should replace the rip rap option with an ecologically preferable oyster reef.

Further Consideration of Marine Restoration Options Needed

The Oil Pollution Act's command to the Trustees regarding NRDA and restoration is to "develop and implement a plan for the restoration, rehabilitation, replacement, or acquisition of the

[1] Ocean Conservancy is a non-profit organization that educates and empowers citizens to take action on behalf of the ocean. From the Arctic to the Gulf of Mexico to the halls of Congress, Ocean Conservancy brings people together to find solutions for our water planet. Informed by science, our work guides policy and engages people in protecting the ocean and its wildlife for future generations.

equivalent, of the natural resources under their trusteeship."[2] The NRDA regulations go a step further to define "restoration." *Restoration* means any action (or alternative), or combination of actions (or alternatives), to restore, rehabilitate, replace, or acquire the equivalent of injured natural resources and services. Restoration includes: (a) Primary restoration, which is any action, including natural recovery, that returns injured natural resources and services to baseline; and (b) Compensatory restoration, which is any action taken to compensate for interim losses of natural resources and services that occur from the date of the incident until recovery.[3]

We recommend NOAA withdraw its preferred alternative and more fully explore and better match compensatory marine restoration options with marine resource injuries or lost services, rather than substituting familiar but potentially less equivalent coastal restoration approaches (e.g., marsh restoration). While the productivity of salt marshes supports the offshore environment and marine food web, only a small fraction of marsh primary production can be expected to reach the incident site about 35 miles off of the coast. Therefore, we do not believe that salt marsh restoration and shoreline protection is the most appropriate course of action in terms of providing the type or amount of ecological services needed to restore or replace those that were lost offshore near the incident site.

The draft DARP states that pelagic fishes, demersal fishes and marine mammals were injured by the Tank Barge *DBL 152* oil spill, yet the nexus between these injuries and the proposed compensatory restoration measures is weak. At the very least, we ask NOAA to clarify the basis for its conclusions about these injuries. Ultimately, we request that NOAA suspend its current course of action and reevaluate the alternative to consider other marine restoration options available to the agency. For example, increasing the capacity of marine mammal stranding networks along coastal Texas and Louisiana to improve rescue and rehabilitation success is a form of compensatory restoration that could speed the recovery of any bottlenose dolphin populations injured by the Tank Barge *DBL 152* oil spill. (An Unusual Mortality Event is still occurring in the northern Gulf and one occurred as recently as 2012 in northern Texas.) The attached report, based on an April 2012 marine restoration workshop, includes a menu of vetted restoration options related to the Deepwater Horizon oil spill that may be applicable to marine resource injuries resulting from the Tank Barge *DBL 152* oil spill.

NOAA also should consider small-scale pilot projects (as allowed under NRDA) to explore the feasibility of alternatives with a stronger marine nexus before a decision to scale up. For example, NOAA considered but rejected the alternative to cap contaminated sediments beneath offshore platform production because of expense, potential environmental impacts and unproven techniques. However, NOAA could propose and proceed with a pilot study at one site (platform), thereby limiting cost and the risk of secondary impacts (e.g., sedimentation of hard bottom habitats in Flower Garden Banks NMS) from the action.

[2] 33 U.S.C. § 2706(c).
[3] 15 CFR Part 990.30.

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Long-term Monitoring of Lingering Oil and Impacts

NOAA monitored the movement and fate of the oil for the first two years after the incident, but discontinued '"long-term monitoring" when efforts to recover oil ended. The DARP says that only a fraction (~5 percent) of the discharged oil was recovered. We know from other marine oil spills that lingering oil can expose or reexpose organisms, resulting in harmful, chronic impacts in animals and impacting ecological interactions (e.g., food web). Storms, currents, trawling and other factors can lead to resuspension or movement of oil that puts marine species and sensitive coastal and marine habitats at risk. The *Exxon Valdez* Oil Spill Trustee Council continues to fund residual oil monitoring more than 20 years after that event.

We recommend that NOAA also continue to monitor the presence, amount, fate and environmental impacts of oil from the Tank Barge *DBL 152* oil spill for a minimum of 10 years. Third parties, such as universities, may conduct existing surveys that NOAA could leverage to collect these data with minimal additional cost to the agency. Monitoring itself informs the restoration process in that the only way to detect delayed or future injuries and guide additional restoration actions is by collecting and analyzing data. As such, monitoring of remaining oil and its impacts should be treated and funded as a critical part of a Tank Barge *DBL 152* oil spill restoration and management of the ecosystem or human uses. A concrete example of the importance of this type of monitoring is informing the shrimp fishing industry of changes in the location of submerged oil offshore so that fishermen can avoid trawling in these areas, spreading the oil and fouling gear.

Damage Assessment Process and Findings

NOAA rejected information on benthic faunal community and trawl and sediment chemistry from samples collected or analyses conducted by the responsible party (RP) because they lacked scientific rigor or fell outside of the joint NRDA work plan. According to the draft DARP, NOAA was not involved in the design or execution of field work and subsequent analysis of the field samples. The fact that NOAA was not involved in these field studies raises questions about quality control and whether the science conducted might have been of higher quality and utility for restoration scaling had NOAA supervised or joined the RP in field sampling.

The DARP says that "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." Despite claims of injury to demersal fishes, pelagic fishes and marine mammals, the DARP does not explain how NOAA arrived at this determination. What observational or analytical methods

or models were used to document or infer injuries to these taxa had occurred? We would like to see the final DARP substantiate these claims of injury or at least explain the scientific basis on which they were made.

This clarification is important because if injuries to these higher order taxa were documented through direct observation or inferred through modeling, the universe of compensatory restoration options available to NOAA to address these injuries expands (see attached report).

Changes to the Preferred Alternative Needed

NOAA's preferred alternative to compensate the public for injured offshore benthic resources and lost productivity is salt marsh restoration and shoreline protection. As explained above, we believe the nexus to the injury is weak and request that NOAA withdraw its preferred alternative and reevaluate offshore marine restoration options instead. However, should NOAA choose to proceed with the preferred salt march and shoreline protection alternatives, we provide the following comments.

The shoreline protection component would be accomplished through the addition of a rip rap breakwater. We have some concerns about the use of rip rap, and we recommend that NOAA replace the rip rap breakwater with an oyster reef to accomplish the goal of protecting Spartina marsh and producing productivity similar to that which was lost in the injured offshore benthic environment. A living shoreline comprised of natural oyster reef has ecological and practical advantages over rip rap.

Rip rap represents an unnatural substrate in estuaries where soft sediments dominate. If rip rap is to be deployed in a parallel orientation to the shoreline, the structure may lead to erosion of the marsh landward of the rip rap revetment. Parallel orientation can interfere with estuarine ecological processes by reducing the connectivity between the marsh behind the revetment and waters on the estuarine side of the artificial structure. Consequently, fishes and crustaceans may lose some ability to move in and out of the high marsh behind the revetment, affecting their use of this important nursery habitat. The erosion of marsh resulting from the rip rap is likely to exacerbate the effects of sea level rise, a serious concern in the area, and thus would decrease coastal resiliency.[4]

Another concern is that the unnatural substratum of rip rap introduced into estuaries where soft sediments dominate can host invasive species.[5] In addition, the habitat conversion rate (1 acre of rip rap equal to .045 acres of offshore bottom habitat) should be justified with actual data in the final DARP. Finally, the rip rap, as proposed, would be built upwards to a higher

[4] Peterson, C.H., R.T. Barber, K.L. Cottingham, H.K. Lotze, C.A. Simenstad, R.R. CVhristian, M.F. Piehler,, and J. Wilson. 2008. National Estuaries. In: Preliminary review of adaptation options for climate-sensitive ecosystems and resources. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Julius, S.H. J.M. West (eds.), J.S. Baron, B. Griffith, L.A. Joyce, P. Karieva, B.D. Keller, M.A. Palmer, C.H. Peterson, and J.M. Scott (Authors)], U.S. Environmental Protection Agency, Washington, DC, USA, pg. 7-1 to 7-108.

[5] Geraldi, N.R. 2012. Oyster reef ecology and restoration: Findings from field and mesocosm studies. University of North Carolina at Chapel Hill, PhD dissertation.

elevation than other breakwater installations. This atypically high relief could be an impediment to public access to and use of the adjacent shoreline.

Ocean Conservancy believes that an oyster reef is ecologically preferable to a rip rap breakwater, potentially resulting in a higher and more sustained environmental and human use return for the investment. East Galveston Bay, the proposed siting of the preferred alternative, has a long history of productive oyster reefs, which are now greatly depleted. While rip rap can support oyster colonization and growth, oyster reef breakwaters generally grow more oysters than do rip rap. As sea level rises, oyster reefs are capable of upward growth and self-renewal, thus providing an advantage over rip rap in terms of resilience. Oyster reefs are vulnerable to storms, but if rendered non-functional by storm damage, the reefs would bioerode more effectively than rip rap and pose less of a hazard. As sea level rises, rip rap could pose a nuisance or hazard to people accessing estuarine waters. The oyster reefs provide essential fish habitat for finfish sought by anglers,[6] and could day one support a sustainable directed fishery. Moreover, oyster filtration benefits the estuary and estuarine organisms by improving water quality.[7] This use of restored oyster reef would follow the guidance of marine resource and restoration experts in the Gulf of Mexico.[8,9]

If rip rap must be used, we seek assurance that the proposed design of the rip rap breakwater (parallel orientation angled at about 45 degrees to the shoreline) is the one planned for implementation. If not, NOAA should explain how the risks we raise above with respect to parallel placement of rip rap would be ameliorated. We also recommend that any rip rap deployed be in the form of concrete and not limestone due to the fact that bioerosion of limestone can occur so rapidly that its value as a substrate for oyster attachment is diminished after about two years.[10] However, the trade off using concrete may be that it could become a hazard or nuisance if rendered non-functional due to storm damage.

Summary

In closing, we would like NOAA to replace the preferred alternative with marine restoration options that better match the injuries and lost services documented in the offshore

[6] Haby, M. G., Russell, J. M., & Falconer, L. L. (2009, June). Hurricane damage sustained by the oyster industry and the oyster reefs across the Galveston Bay system with recovery recommendations. A Texas AgriLife Extension Service/Sea Grant Extension Program Staff Paper. (TAMU-SG-09-201). College Station, TX: Texas A&M University.
[7] Grabowski. J.H., R.D. Brumbaugh, R.F. Conrad, A.G. Keeler,J.J. Opaluch, C.H. Peterson, M.F. Piehler, S.P. Powers, and A.R. Smyth. 2012.Economic valuation of ecosystem services provided by oyster reefs. BioScience 62: 900-909.
[8] Peterson, C.H., F.C. Coleman, J.B.C. Jackson, R.E. Turner, G.T. Rowe, R.T. Barber, K.A. Bjorndal, R.C. Carney, R.K. Cowen, J.M. Hoekstra, J.T. Hollibaugh, S.B. Laska, R.A. Luettich, Jr., C.W. Osenberg, S.E. Roady, S. Senner, J.M. Teal, and P. Wang. 2011. A Once and Future Gulf of Mexico Ecosystem. Pew Charitable Trusts, Philadelphia, PA. www.PewEnvironment.org.
[9] Gulf of Mexico University Research Collaborative and Ocean Conservancy. 2012. Marine Restoration Priorities & Science Principles: Results of the Expert Panel Workshop in St. Petersburg, Florida on April 24-25, 2012. Hosted by the Florida Institute of Oceanography.
http://www.marine.usf.edu/gomurc/docs/Marine_Restoration_Workshop_Report-9-6-12.pdf
[10] Personal Observation. Dr. Niels Lindquist, University of North Carolina at Chapel Hill, Institute for Marine Science, 3431, Morehead City, NC 28557.

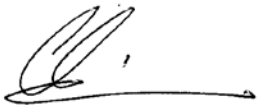
environment. We would also like NOAA to clarify the injuries to demersal fishes, pelagic fishes and marine mammals that the agency says resulted from the Tank Barge *DBL 152* oil spill. The attached report provides a menu of compensatory restoration strategies for injuries to marine resources, and we encourage NOAA to consult this resource to better match marine restoration alternatives with injuries to demersal or pelagic fishes or marine mammals resulting from the *DBL 152* oil spill.

If NOAA proceeds with the preferred alternative as part of a wider suite of restoration options in the final DARP, we recommend NOAA substitute an oyster reef (living shoreline) for the proposed rip rap breakwater because we believe the ecological services would be greater and liabilities lower if an oyster reef were selected as the preferred alternative for protecting the shoreline. Finally, we recommend NOAA commit to undertaking or funding long-term monitoring of the remaining oil, particularly its fate and environmental impacts, and the status and recovery of natural resources.

In general, we believe that NOAA, as the lead trustee for federal waters, should devote more effort to identifying creative compensatory restoration approaches for marine resources injured by accidental oil discharges. Resorting to traditional restoration approaches, such as those proposed in the draft DARP, are entirely appropriate for injuries to coastal or nearshore resources, but are not justified for restoring offshore resources or services because their nexus to the marine injury is weak. As oil and gas production continues to expand into deeper and more remote marine waters in the Gulf of Mexico and the probability of accidental discharges increases, NOAA should be prepared to think more expansively and creatively about the range of marine restoration options. If NOAA does not show the way in regard to marine restoration, no other agency will step forward to do so. We hope NOAA finds the attached report helpful in this regard.

Ocean Conservancy appreciates your consideration of our recommendations and welcomes an opportunity to discuss these issues further with you. Please do not hesitate to contact me at 512-524-7445 or Gulf Restoration Program Director Bethany Kraft at 504-208-5814 with questions.

Sincerely,



Chris Robbins
Senior Restoration Manager
Restoration Planning

Attachment: Marine Restoration Workshop Report

Marine Restoration Priorities & Science Principles:

Results of the Expert Panel Workshop in St. Petersburg, Florida on April 24-25, 2012

Co-sponsored by the
Gulf of Mexico University Research Collaborative
and Ocean Conservancy

Hosted by Florida Institute of Oceanography

September 2012

GOMURC
GULF OF MEXICO UNIVERSITY RESEARCH COLLABORATIVE

Ocean Conservancy
Start a Sea Change

STATE OF FLORIDA
FIO
INSTITUTE OF OCEANOGRAPHY

Workshop Cosponsors

The Gulf of Mexico University Research Collaborative

The Gulf of Mexico University Research Collaborative (gomurc.org) is comprised of university consortia that include: the Alabama Marine Environmental Sciences Consortium, the Florida Institute of Oceanography, the Louisiana Universities Gulf Research Collaborative, Mississippi Research Consortium, and the Texas Research Consortium. GOMURC's mission is to work collaboratively as a university-based research consortium within the Gulf states of Alabama, Florida, Louisiana, Mississippi and Texas in pursuit of scientific knowledge and understanding that informs decisions on state, regional, national and international resource management and policy and practices affecting the Gulf of Mexico ecosystem and economy.

Ocean Conservancy

Ocean Conservancy (oceanconservancy.org) educates and empowers citizens to take action on behalf of the ocean. From the Arctic to the Gulf of Mexico to the halls of Congress, Ocean Conservancy brings people together to find solutions for our water planet. Informed by science, Ocean Conservancy's work guides policy and engages people in protecting the ocean and its wildlife for future generations. With staff and offices in St. Petersburg, Florida; Mobile, Alabama; Baton Rouge and New Orleans, Louisiana; and Austin, Texas, Ocean Conservancy has been deeply engaged in Gulf of Mexico fisheries work for more than two decades and intensively on restoration of the Gulf ecosystem since the BP Deepwater Horizon oil disaster.

Workshop Venue

The Florida Institute of Oceanography

In 1967, the Florida Board of Regents formed the Florida Institute of Oceanography (FIO) to unite scientists with a common interest in the ocean and to facilitate the sharing of limited lab and vessel capabilities. In 2009, FIO became an Academic Infrastructure Support Organization in the State University System, hosted by the University of South Florida College of Marine Science. The FIO mission is to facilitate and support Florida's emergence as the pre-eminent state in the nation for coastal ocean education. Development of educational and research infrastructure supports faculty and scientists working to understand coastal and ocean processes and communicate science-based understanding to Florida's residents, educators, policy makers and resource managers.

Citation: Ocean Conservancy and the Gulf of Mexico University Research Collaborative. 2012. Marine Restoration Priorities & Science Principles: Results of the Expert Panel Workshop. Marine Restoration Workshop (April 24-25, 2012), St. Petersburg, Florida. Available online at http://www.research.usf.edu/absolute-news/templates/?a=333&z=32

Table of Contents

Executive Summary

Recognizing that the large-scale, multi-dimensional nature of the Deepwater Horizon (DWH) oil disaster in the Gulf of Mexico requires novel and expanded approaches for marine restoration, Ocean Conservancy and the Gulf of Mexico University Research Collaborative (GOMURC) convened experts from academic, governmental, and non-governmental institutions and from fishing groups to serve as panelists in a workshop hosted by the Florida Institute of Oceanography. At this workshop, 17 marine resource experts identified and ranked 69 marine restoration priorities across the four themes of ocean habitats, fishery resources, marine wildlife and human uses.

This report first summarizes those restoration options in priority order to guide the nomination, selection and monitoring of projects addressing injuries to or lost uses of marine natural resources resulting from the DWH disaster. Second, the report describes scientific principles for effective restoration – a checklist of key issues to help government agencies develop and implement a successful Gulf restoration program.

The DWH disaster originated offshore, and the discharged hydrocarbons persisted at depth due to chemical dispersant use at the well head rather than solely on the surface, creating unanticipated problems for offshore deepwater, midwater and pelagic habitats. Exposure of living marine resources to petroleum hydrocarbons, dispersants and response activities likely resulted in injuries to and lost human uses of those resources. In addition, the timing and location of the disaster coincided with important biological phenomena in the Gulf (e.g., fish spawning), which raises additional concerns about the disaster's marine impacts.

Because the DWH hydrocarbon discharge was unprecedented in size, depth, duration, and distance from shore, there is relatively little experience to guide the planning and implementation of restoration measures specifically for the marine environment, with emphasis on offshore habitats, species and human uses. This report focuses on marine ecosystem priorities in order to supplement and complement the assessments and resources that are devoted, appropriately, to the restoration of coastal environments.

Summary of marine restoration priorities

Regardless of the marine focus, the reality is that terrestrial, coastal and marine environments are inextricably intertwined. As such, restoring the resiliency and productivity of U.S. Gulf of Mexico waters will require a comprehensive, ecosystem-wide approach with significant investments in the upland watershed, coastal (e.g., wetlands) and marine environments. This report identifies key ways in which marine restoration can be a significant part of the plans for overall Gulf of Mexico restoration.

Specifically, the cosponsors recommend that the DWH Natural Resource Damage Assessment (NRDA) Trustee Council, the Gulf Coast Ecosystem Restoration Task Force (GCERTF), and the Gulf Coast Ecosystem Restoration Council (Restoration

Council) consider projects along the full ecological spectrum in order to address injuries to marine benthic and pelagic resources and to help strengthen the resilience of coastal communities. The following table identifies the projects that are the highest priorities as ranked by the expert panel.

Table 1. Top five marine restoration priorities from each of the four themes identified by marine resource experts in the workshop

Workshop Theme	Purpose
Ocean Habitats	
Create a targeted monitoring program to understand current threats of existing oil and gas infrastructure and pollution (including chronic pollution) to Gulf biota	Detect harm from oil spill disaster
Establish permanently-funded, long-term, Gulf-wide ecosystem monitoring, ocean observation, research, and modeling programs	Track recovery of affected biota and improve knowledge of ecosystem function, structure, and condition for adaptive management
Identify, explore, map and characterize ecologically and economically important habitats	Increase knowledge of habitat and biological community associations for improved stock assessments and informed recovery strategies
Protect continental shelf and slope benthic "live bottom" habitats and adjacent "halo" of soft bottom areas from incompatible uses	Maintain productivity of areas important to foraging and fishery species, macro-invertebrates and mesophotic and deep sea coral communities to compensate for harm to impacted areas
Re-establish or protect oyster reefs focusing on production and non-production reefs in areas of historic abundance	Increase productivity and function of habitat important to marine species and key ecosystem service of recreational and commercial fishing
Fishery Resources	
Supplement existing and develop new fishery-independent surveys to collect abundance and life history data	Use data to determine rates of recovery for impacted species and to inform adaptive fishery management
Invest in field and lab research to better understand acute and chronic effects of oil and dispersants on fish and invertebrate species	Derive better estimates of lethal and sublethal effects to inform population health assessments and management decisions
Collect, compile, and synthesize existing biological and socioeconomic data and identify and prioritize data needed to undertake ecosystem assessments in the Gulf of Mexico, in support of Gulfwide Integrated Ecosystem Assessment (IEA)	Apply IEAs to evaluate and understand trade-offs of different recovery strategies for impacted marine resources or ecosystem services
Conduct more frequent stock assessments for impacted finfish species that are overfished or near overfished	Determine whether catch targets may need to be adjusted to account for changes in populations detected in years after oil spill
Develop a large-scale fish DNA and smart tagging program	Produce more accurate estimates of stock abundance and examine population connectivity within Gulf fishes and better understand species-specific resiliency
Marine Wildlife	
Assess the impacts of low-level exposure and breakdown of oil, oil products and chemical dispersants on wildlife	Enhance understanding of DWH impacts and inform restoration planning

Develop a large-scale innovative tagging program for sea turtles, seabirds and marine mammals to contribute to baseline information on their abundance and distribution	Improve estimates of abundance, movement patterns, somatic growth, mortality and reproductive vital rates and help determine recovery trajectories and impacts of future episodic events on populations
Fund research and development of new techniques for reducing impacts to wildlife resulting from fisheries interactions	Reduce mortality associated with fisheries interactions and hasten recovery of injured populations, while minimizing operational costs for fishermen
Protect existing sea turtle nesting beaches, reduce incompatible human activities, and study the effectiveness of nest relocation programs	Facilitate recovery of injured sea turtle populations
Expand and improve wildlife stranding networks and response capacity throughout the Gulf	Gather important biological information on impacted species for monitoring population status, detect distressed animals for rehabilitation and release back into the wild, and evaluate rehabilitation effectiveness
Human Uses	
Conduct baseline and annual socioeconomic valuations of Gulf of Mexico fisheries; invest in standardization of socioeconomic fisheries data collection among Gulf states	Ensure relevant information is accurate, consistent and readily available for use in claims preparation and NRDA compensation for eligible services
Examine chronic socioeconomic impacts of DWH on commercial, recreational and subsistence fisheries	Track lingering impacts of disaster on fisheries and relevant communities so that assistance can be directed accordingly
Conduct a baseline assessment and establish benchmarks for a socioeconomic valuation of Gulf of Mexico nonuse ecosystem services	Develop accurate estimates of lost services such as tourism and wildlife viewing so that communities dependent on them can be fairly compensated
Gather baseline data on subsistence use of resources, using the Alaska-based methodology as a model for this activity	Ensure subsistence uses of Gulf resources are documented to develop accurate estimates of lost uses
Fund overarching database management that includes the following: 1) sustaining integrated Gulf-wide Digital Atlas (NOAA ERMA), and 2) developing data management agreement between funding agencies and vendors that defines data management requirements and resolves proprietary use issues	Improve public access to information on the Gulf's biological and socioeconomic value in ways that encourage collaborative actions to protect the environment

Guiding principles for restoration program success

The following 15 guiding principles would help ensure that the restoration program is science-based and rigorous, ecologically comprehensive (from coast to offshore marine), integrated across state and federal jurisdictional lines, adaptive and open to public input.

Table 2. In short, a restoration program should:

• Rely on an understanding of the ecosystem, reflected in a descriptive model and updated periodically based on results of monitoring and research activities
• Embrace science to support, guide and evaluate projects, with increased knowledge itself seen as a form of restoration and recovery if incorporated into management
• Include a commitment to gather necessary data to advance understanding of the ecosystem,

including basic processes, and to inform restoration
• Support integrated long-term monitoring, research, observing and modeling
• Integrate restoration project planning and implementation within and across programs (DWH NRDA, GCERTF, Restoration Council) to avoid duplication, promote ecological balance in project portfolio, maximize efficiencies and support common goals
• Take into account and monitor climate change (especially temperature and pH) and other types of environmental change and degradation that impact ecosystem resilience (e.g., pollution, overfishing, habitat destruction and invasive species)
• Embrace a Gulfwide ecosystem approach, including interdisciplinary studies and Integrated Ecosystem Assessments, based on a regional science plan to guide the investments that should be made in monitoring, research, observing and modeling
• Commit to ongoing synthesis of results and communication to scientists, policy-makers and the public – including annual Gulf restoration science symposia and building upon Gulf of Mexico Research Initiative (GoMRI) annual science meetings
• Rely on independent peer review at both program and project levels, including proposals, reports, plans and publications
• Work with Gulf regional planning and management organizations to anticipate, coordinate and expedite project environmental compliance and research – including permitting – for project implementation and timeliness in data collection
• Apply lessons of the DWH oil spill to future NRDA and other assessment programs to promote improved baseline information and more rapid acquisition of data on natural resource damage, which is critical as ultra-deepwater drilling increases
• Maintain data to facilitate access and appropriate uses by scientists, resource managers and the public, consistent with national guidelines and metadata and archive standards. Potential models/outlets: National Coastal Data Development Center, GoMRI and Gulf of Mexico Alliance data management programs
• Sustain monitoring required for adaptive management to inform and improve project design and resource management
• Rely on periodic open requests for proposals (RFP); the results and performance of prior projects should inform the RFP content
• Promote public awareness, accountability and transparency, and meaningful participation

If this report's marine restoration priorities and principles are adopted in overall Gulf restoration, the entire Gulf ecosystem and the Gulf Coast economy will benefit. A robust, long-term, Gulfwide monitoring, research and observation program would contribute the supporting science needed not only to restore the resources on which the Gulf states depend, it would also provide the stream of information needed to assess environmental harm that may become evident in the future. The Gulf of Mexico is a national treasure, and the DWH disaster has provided an opportunity to ensure that the Gulf is understood scientifically and restored to pre-spill natural resource productivity. Combined with the potential under the RESTORE Act for correcting long-term degradation, a comprehensive, Gulfwide restoration program that includes both applied science and innovative marine restoration projects has the potential not only to help the Gulf ecosystem recover, but also to enable Gulf Coast economies to use the Gulf in ways that ensure its sustainability for the future. This report and the work of the experts who served on the marine restoration panel offer concrete recommendations and a path forward as the NRDA Trustees, the Gulf Coast Ecosystem Restoration Task Force and the Gulf Coast Ecosystem Restoration Council make decisions about restoration plans and projects.

Introduction

Figure 1. Researchers and fishermen have found a greater incidence of lesions on red snapper and other fish in Desoto Canyon near the Deepwater Horizon well blowout than in other areas of the Gulf. Photo credit: James Cowan, LSU.

Restoring the Gulf of Mexico, a priority for the region and country

The BP Deepwater Horizon (DWH) oil disaster impacted the U.S. Gulf of Mexico marine and coastal environments and communities over a wide area, reminding the country of the Gulf's vulnerability to disasters that threaten multi-billion dollar industries in energy, seafood and tourism, which are critical to the regional economy and national interests. Acute events like the DWH disaster and chronic sources of stress such as hypoxia and low freshwater flows erode the resiliency and productivity of this large marine ecosystem.

Millions of people visit the Gulf for recreation, viewing wildlife, fishing and hunting, which contribute to a $35 billion tourism industry and support hundreds of thousands of jobs. The Gulf accounts for 40 percent of the continental U.S. commercial fishery landings by weight and 41 percent of all fish caught recreationally in the United States[1]. The seafood industry generates an additional

[1] NOAA. (2011). Fisheries of the United States-2010. Available at http://www.st.nmfs.noaa.gov/st1/fus/fus10/FUS_2010.pdf

$10.5 billion in economic activity. The Gulf, in addition to its importance to local communities and the country as a whole, harbors more than 15,000 species and provides critical habitat for migratory species en route to nesting or foraging grounds.

Evidence of harm or potential harm (Figure 1) resulting from the DWH disaster is the subject of intense study, and the results of these studies will be used to develop targeted restoration strategies and projects for injured natural resources and lost services. Investing in long-term restoration of marine and coastal resources is essential to reversing the effects of the DWH disaster and longstanding sources of environmental stress. Improving the overall condition of the Gulf ecosystem through investments in restoration is vital to the prosperity, security and quality of life in the region.

Seizing the opportunity

The Gulf region has a rare and unprecedented opportunity to accelerate the recovery of marine species, habitats and ecosystem services by directing funds to high-value, high-impact restoration projects. Indeed, the five states surrounding the Gulf of Mexico are positioned to receive a significant level of funding dedicated to restoration resulting from the DWH oil disaster. For example, the government will secure compensation for the DWH oil disaster from responsible parties through resolution of a Natural Resource Damage claim, Clean Water Act (CWA) fines, or other civil or criminal penalties. Under the RESTORE Act signed into law on July 6, 2012, roughly 80 percent of the fines collected for violations of the CWA (potentially billions of dollars) will flow to the Gulf region for environmental restoration and economic recovery once the legal issues are resolved.

Context

On April 20, 2010, the deep-water Macondo well located 50 miles off Louisiana's coast experienced a catastrophic and tragic blowout, killing 11 workers aboard the Deepwater Horizon (DWH) platform (Figure 2). The ruptured wellhead discharged nearly 5 million barrels of crude oil into the northern Gulf of Mexico, resulting in the largest human-caused, unintentional oil spill in world history. The DWH disaster exposed the marine environment to crude oil, including toxic polycyclic aromatic hydrocarbons and weathered oil. Responses to the spill (e.g., surface burning, chemical dispersants distributed at the surface and at the wellhead, deployment of booms, sea turtle nest relocations, beach clean-up and other response activities) are additional sources of potential injury.

Figure 2. The Deepwater Horizon drilling rig is engulfed in flames after the catastrophic Macondo well blowout, resulting in the largest unintentional oil disaster ever documented. Photo credit: U.S. Coast Guard

The Oil Pollution Act of 1990 requires the public and environment to be made whole following natural resource injuries and lost services caused by events like the DWH disaster. Designated state and federal government agencies (Trustees) accomplish this goal by restoring, rehabilitating or replacing the damaged natural resources, or by acquiring resources and/or services equivalent to those injured or lost. Injuries to publicly-owned natural resources and the loss of services provided by those resources are documented through the Natural Resource Damage Assessment (NRDA). A Programmatic Environmental Impact Statement (PEIS) and restoration plan is in development for the DWH disaster and, based on NRDA injury assessments, will guide restoration planning and decisions. The Draft DWH Oil Spill PEIS, to be released in late 2012 or early 2013 for public comment, will include a range of restoration types and alternatives from which the Trustees will select preferred alternatives for guiding individual project selection.

Restoration Funding

The responsible parties (e.g., including but not necessarily limited to BP) must pay for restoration to make the public whole for what was harmed or lost. In the case of the DWH disaster, BP, as one of the responsible parties, made a voluntary $1 billion down-payment for early restoration projects under an agreement with

Trustees. The restorative value of these projects is calculated as an injury offset that is applied as credit toward a future Natural Resource Damage claim. The trustees are moving forward with eight early restoration projects totaling $62 million,[2] seven of which address restoration of estuarine and shoreline habitats and one which addresses lost human uses (Figure 3). A second round of proposed early restoration projects directed by the Trustees is in the final stages of approval.

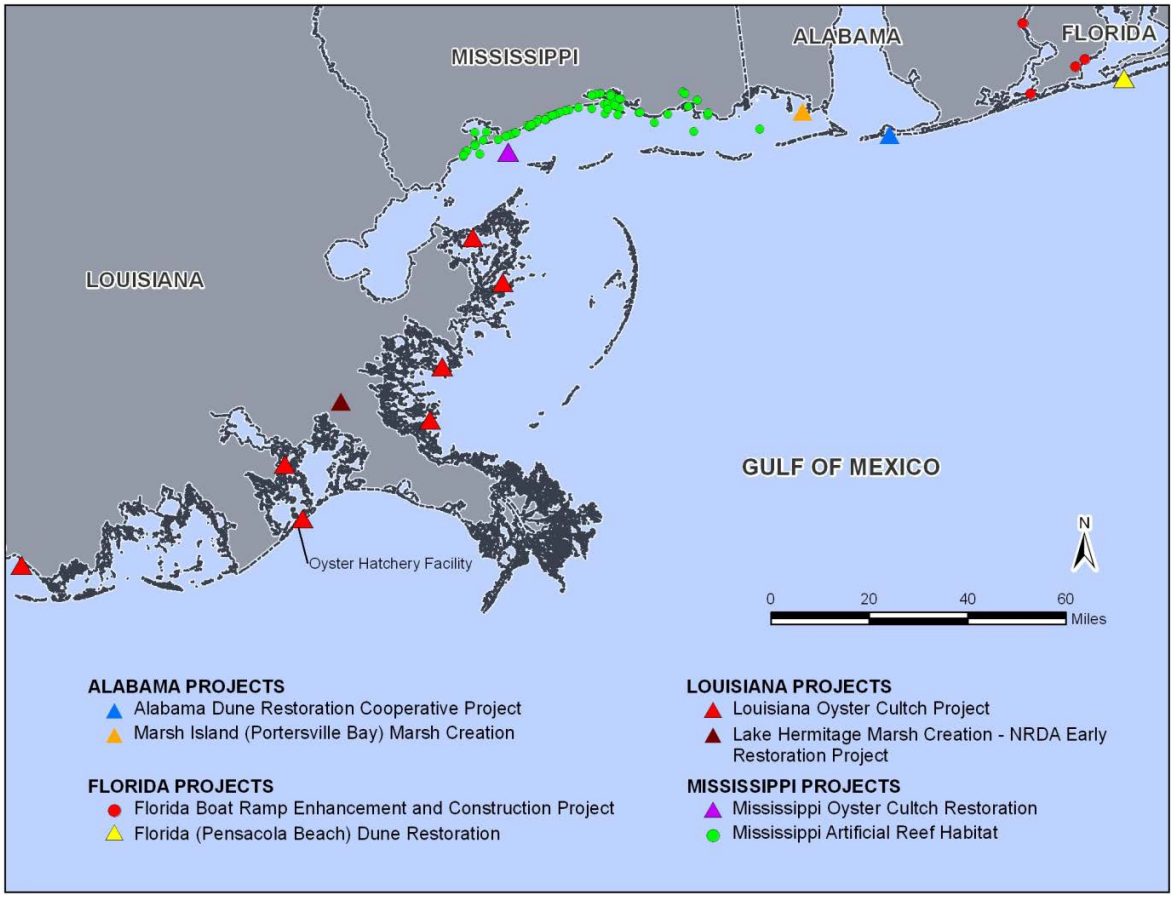


Figure 3. Location of Phase I early restoration projects. Map source: DWH NRDA Trustees

As of September 2012, the DWH NRDA is still underway. It could be many months or even several years before the full extent and significance of oil spill injuries to marine species and environments and lost services are understood. That certainly has been the case following the *Exxon Valdez* oil spill. While the NRDA is still ongoing, the injuries to marine resources (e.g., acute and chronic wildlife mortalities) and related lost uses (e.g., commercial and recreational fishery closures) that have already been documented (Appendix I) underscore the need for immediate restoration of marine species and habitats (Figure 4). In April 2012, Trustees released a NRDA update, summarizing known and possible impacts

[2] Plan available at http://www.gulfspillrestoration.noaa.gov/wp-content/uploads/Final-ERP-EA-041812.pdf.

caused by the DWH disaster and ongoing injury assessment studies.[3] Peer-reviewed, published research conducted outside of the NRDA process could reveal further evidence of marine environments impacted by the disaster that also require restoration attention. For example, the Gulf of Mexico Research Initiative (GoMRI) received a 10-year, $500 million commitment from BP to fund independent research on the environment's response to the oil spill, among other study areas (Appendix II). The results of many of these GoMRI-funded studies are expected to be published in peer-reviewed scientific journals and to contribute to the body of knowledge on oil spill impacts and restoration.

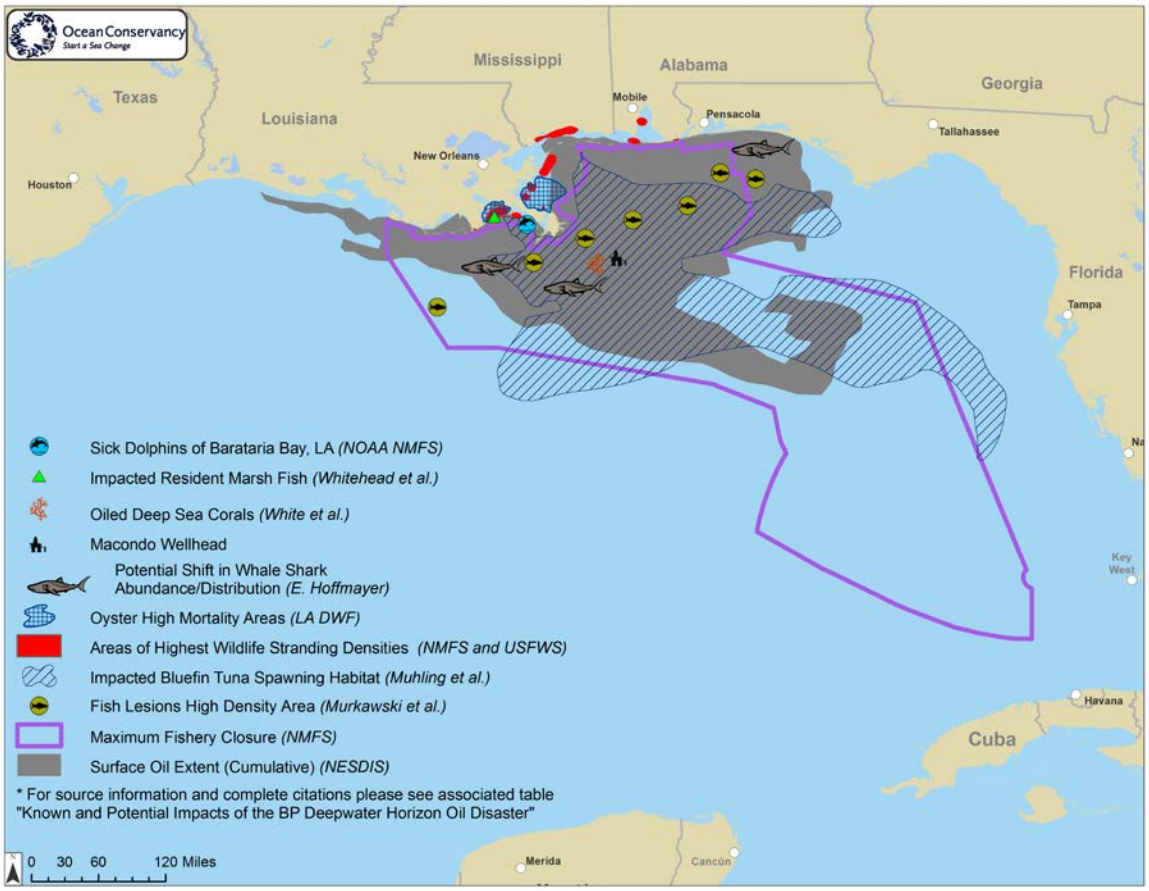


Figure 4. Examples of known or potential impacts of the Deepwater Horizon oil disaster on the marine environment. See Appendix I for more information.

The most significant source of funding for restoration outside of OPA and the NRDA process may be the federal Clean Water Act (CWA). The CWA makes it unlawful to discharge oil into navigable waters or along shorelines, and fines range from $1,100 to $4,300 per barrel discharged.[4] Typically, CWA penalties for oil discharge are deposited into the Oil Spill Liability Trust Fund and can be used to reimburse oil pollution removal costs. In the case of the DWH disaster, however,

[3] Update is available online at http://www.gulfspillrestoration.noaa.gov/wp-content/uploads/FINAL_NRDA_StatusUpdate_April2012.pdf.
[4] 33 U.S.C. § 1321.

Congress took action to redirect most of the CWA fines to the Gulf for ecosystem restoration and economic recovery. In his September 2010 report to the President, the Secretary of the Navy, Ray Mabus, recommended that Congress dedicate a significant portion of recovered CWA fines from responsible parties to the Gulf Coast for long-term ecosystem restoration[5]. The National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling recommended that Congress redirect 80 percent of CWA fines to Gulf restoration.[6]

In July 2012, President Obama signed into law the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act), subtitle F, in the Surface Transportation Bill (S1813, HR4348). The RESTORE Act directs 80 percent of CWA penalties to a Gulf Coast Restoration Trust Fund (Trust Fund), while the Oil Spill Liability Trust Fund receives 20 percent (Figure 5). The amount and availability of CWA penalties for the Trust Fund will be determined through resolution of legal proceedings among the U.S. government, BP and other responsible parties.

Section 1603 of the RESTORE Act directs 35 percent of the annual amount available from the Trust Fund to Gulf Coast states in equal shares for qualifying economic and ecological restoration activities. Section 1603 also establishes a Federal-State Gulf Coast Ecosystem Restoration Council (Restoration Council) to develop and fund a comprehensive plan for the ecological recovery and resiliency of the Gulf of Mexico. In developing this plan, the new Restoration Council is required to consult the Gulf of Mexico Regional Ecosystem Restoration Strategy, released by the state-federal Gulf Cost Ecosystem Restoration Task Force (GCERTF) in December 2011. The Restoration Council is authorized and directed to support comprehensive plan activities with 30 percent of the Trust Fund, plus a portion of Trust Fund interest.

The Gulf states will receive another 30 percent of the Trust Fund based on an allocation formula to implement activities that contribute to the overall economic and ecological recovery of the Gulf Coast; state expenditures from this allocation must take into consideration the Restoration Council's comprehensive plan and must be consistent with the goals and objectives of the plan. Section 1604 splits evenly the remaining 5 percent from the Trust Fund between a Gulf science program called the Gulf Coast Ecosystem Restoration Science, Observation, Monitoring and Technology Program and Centers of Excellence (COE) in each state, with the science program and COE each receiving, in addition, 25 percent of the Trust Fund interest. The Gulf of Mexico Fishery Management Council has an advisory role in the development of the Gulf science program.

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[5] Mabus, R. (2010). *America's Gulf Coast: A long-term recovery plan after the Deepwater Horizon oil spill*. http://www.epa.gov/indian/pdf/mabus-report.pdf.

[6] Graham, B., Reilly, W. K., Beinecke, F., Boesch, D.F., Garcia, T.D., Murray, C.A., & Ulmer, F. (2011). *Report to the President: National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling*. http://www.gpoaccess.gov/deepwater/index.html.

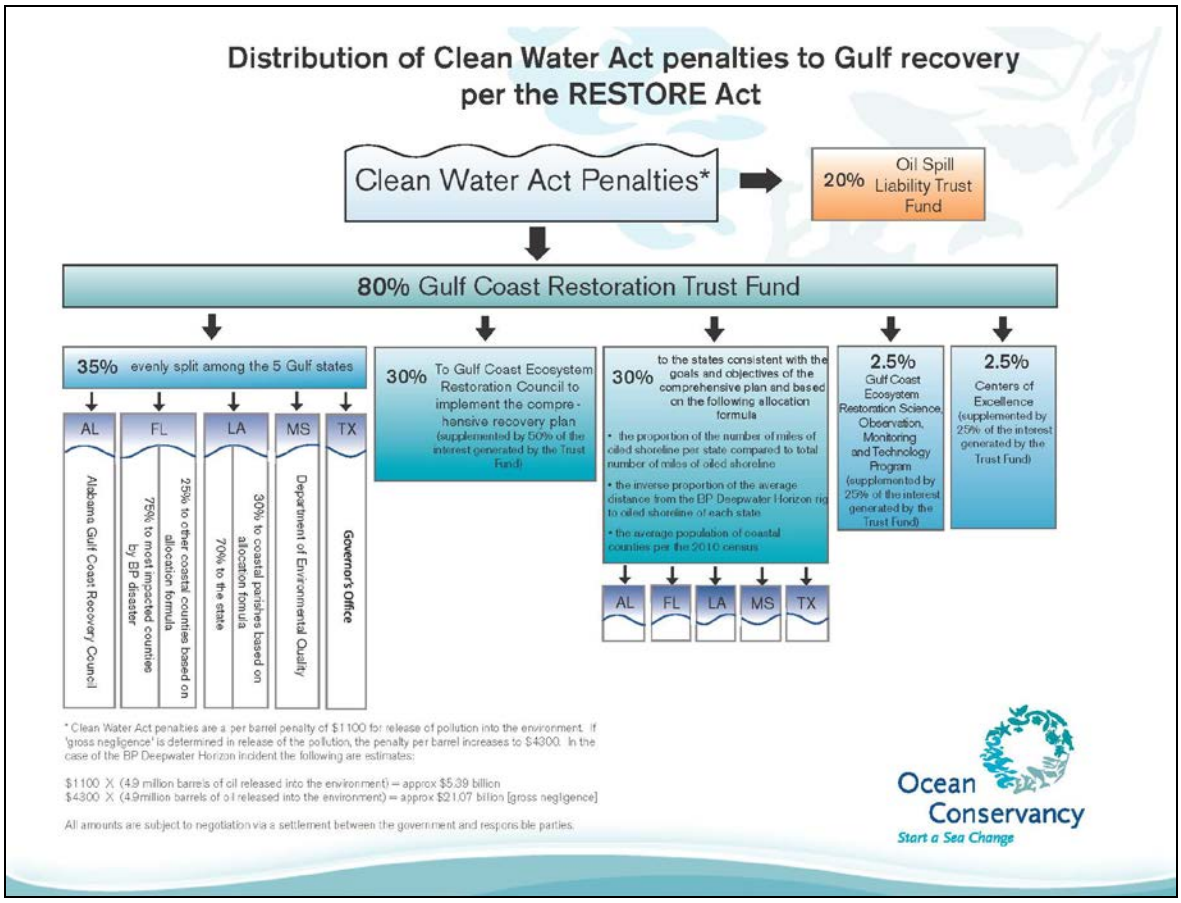

Figure 5. RESTORE Act funding allocations.

Other federal statutes, including the Migratory Bird Treaty Act, the Endangered Species Act, and the Marine Mammal Protection Act, represent potential additional sources of funding for Gulf restoration should the government assess fines from BP and other responsible parties for violations of these statutes. Some Gulf states are also pursuing damages for harm to natural resources through their own state laws.

Purpose of the Workshop

The Gulf of Mexico University Research Consortium and Ocean Conservancy, recognizing that the large-scale, multi-dimensional nature of the DWH disaster required an expanded and unique set of approaches for marine restoration, combined forces to convene a group of marine resource experts to address the most critical restoration needs of the region. The intended goal was to produce a suite of options aimed specifically at the recovery of marine resources impacted by the DWH disaster and pre-existing environmental degradation, and to develop a list of best practices for an effective restoration program.

This document presents the results of the workshop with the aim of informing the public and stakeholders as well as helping state, regional and federal decision-makers develop the strongest possible investment plan for marine restoration

based on the DWH Oil Spill Natural Resources Damage Assessment and priorities identified by GCERTF and the Restoration Council.

Scope

The DWH disaster was unprecedented in size, depth, duration and distance from shore, and there is relatively little experience to draw on in planning and implementing restoration measures specifically for the marine environment, with emphasis on offshore habitats, species and human uses. Offshore generally includes those waters more than 3 nautical miles (NM) from the coast[7], from the seafloor to the pelagic (water column and surface) realm. For these reasons, and because there already is substantial work and a great deal of experience with and resources devoted to restoration of coastal environments (Figure 6), the scope of the workshop focused on the marine environment. The cosponsors' intent is to supplement and complement the substantial list of coastal restoration projects with priorities focused on marine ecosystems.

Among the marine priorities included in this report are a few coastal restoration options that directly support the recovery of vulnerable living marine resources or marine ecosystem services. For instance, some coastal or nearshore projects may restore marine resources by supporting key life stages in coastal or nearshore waters that lead to improvements in fish or wildlife populations or human uses of marine resources farther offshore. Protecting critical beach nesting grounds for marine species such as sea turtles and restoring nearshore fisheries (e.g., oysters) are two such examples. Regardless of the workshop's marine focus, the reality is that terrestrial, coastal and marine environments are inextricably intertwined. As such, restoring the resiliency and productivity of U. S. Gulf of Mexico waters will require a comprehensive, ecosystem-wide approach with significant investments in the upland watershed (Figure 8), the coastal zone (e.g., wetlands) and the marine environment. This report identifies key ways in which marine restoration can be a significant part of the plans for overall Gulf of Mexico restoration.

[7] State waters off Texas and Florida extend from shore out 9 nautical miles (NM), while state waters off Alabama and Mississippi extend from shore out 3 NM and Louisiana out 3 imperial NM. Federal waters extend from state waters out 200 NM.

Figure 6. River meets ocean: Many marine species rely on the estuaries of the Mississippi River Delta during the developmental stages of their life cycles. Photo credit: NASA

Ranking marine restoration options

Marine resource experts and stakeholders identified and ranked marine restoration options during and following a two-day marine restoration workshop on April 24 and 25, 2012, in St. Petersburg, FL, at the Florida Institute of Oceanography. Seventeen panelists, affiliated with academic, government and non-governmental institutions located or working in the Gulf region (Appendix III), participated in the working group; their involvement was based on expertise in fisheries science and management, ecosystem monitoring, marine mammals, sea turtles, sea birds, habitat mapping, marine oil spill impacts, fish population assessments, fishery economics, and commercial and recreational fishing. The cosponsors also invited three representatives from the commercial, private recreational and charter for-hire fishing communities. In addition, several invited observers—representing Trustee agencies, regional restoration planning bodies, state or federal resource management agencies and nongovernmental organizations—also attended.

Panelists evaluated each option with respect to four threshold and seven supplemental criteria (as described in Appendix IV). Threshold criteria were adapted from the Oil Pollution Act (OPA) regulations and were used to indicate the

degree to which an option would likely qualify for selection under the act.[8] These criteria included nexus to injury, feasibility, likelihood of success, and cost effectiveness.

Results

Restoration Option Priorities

The panelist-selected marine restoration options were organized into two main restoration types, as defined in the NRDA regulations: primary and compensatory restoration. Primary restoration is any direct or onsite action (e.g., habitat improvement) that accelerates the return of a resource to its pre-oil spill baseline condition. Compensatory restoration is any action, typically offsite and indirect (e.g., protecting high-value habitat outside the DWH oil spill impact zone), taken to compensate for interim losses of natural resources and services that occur from the date of the incident until recovery.[8] Compensatory restoration aims to replace or acquire natural resources or services equivalent to those that were injured and lost.

Figure 7. A loggerhead sea turtle swims in a floating S*argassum* mat. These pelagic algal mats were in direct contact with oil and dispersants. Photo credit: Blair Witherington

[8] 15 C.F.R. 990.54
[8] 15 C.F.R. 990.30

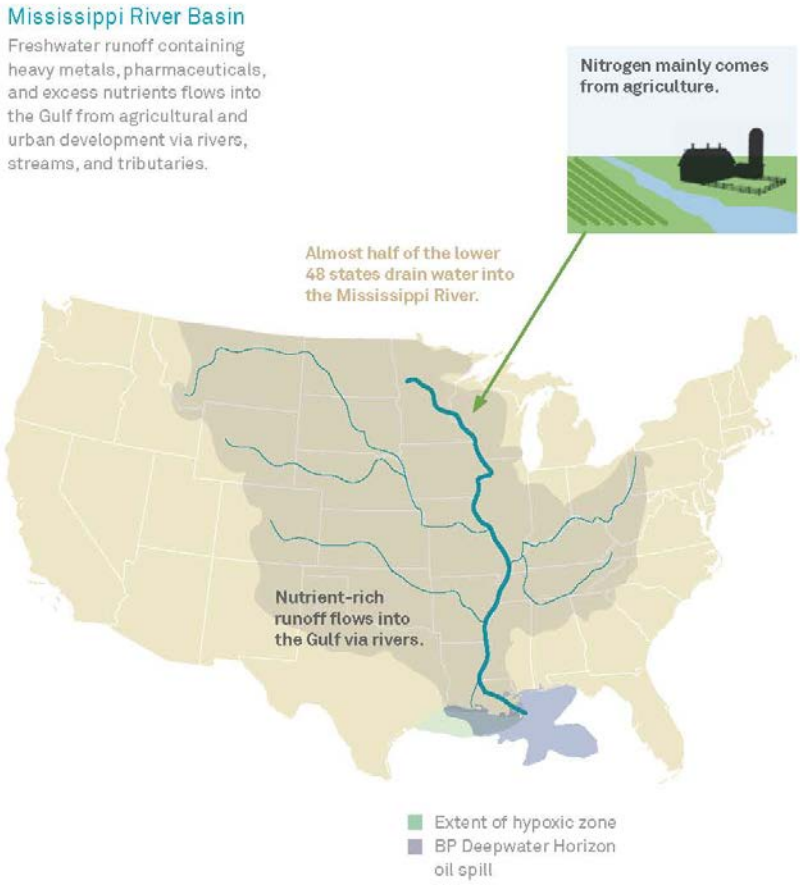

Figure 8. Much of the Gulf hypoxic zone overlaps with the footprint of the DWH oil disaster.

Priority options are further subdivided into major categories under primary and compensatory restoration (Table 6). Primary restoration categories are onsite habitat protection or improvements, restoration research, monitoring, and observation, management, and public outreach and education. Compensatory restoration categories are offsite habitat improvements, restoration science spanning research, monitoring and observation, management, and public outreach and education (Table 6). Onsite is defined as the site of injury, and offsite is any site inside or outside the oil spill impact zone that was not visibly oiled or injured.

Some proposed restoration projects in the marine environment, particularly direct, physical restoration of habitats and species with offshore pelagic (Figure 7) or benthic distributions, may not be technically possible or cost effective. Thus, a more feasible form of primary restoration may be through habitat protection or fishery management actions directed at limiting or mitigating human activities that could interfere with the recovery of marine habitats, species or human uses. One pattern emerging from the marine restoration priorities in Table 6 is the high proportion of compensatory options related to increasing scientific capacity and resource management effectiveness. New or expanded research, monitoring and

observation activities are common across the four themes. Panelists consistently identified scientific or technological investments and management actions as top restoration priorities.

The unique circumstances of the DWH oil spill and the resulting injuries to offshore resources such as benthic habitats and pelagic finfish will necessitate creative approaches under NRDA. The emphasis on science in compensatory restoration priorities, for example, underscores the importance of this type of investment in better understanding the impacts to injured species in the food web, facilitating and tracking resource recovery and identifying appropriate restoration measures. It is only through ecosystem or fishery-wide research and monitoring that sublethal effects or possible additional impediments to recovery (e.g., bycatch mortality) will be detected and the effectiveness of restoration activities can be truly assessed. For example, many panelists identified as a priority increasing the observer coverage across Gulf fisheries (Table 4, F-10; Table 5, M-14) to improve quantification of interactions between fishing activities and non-target species mortalities so that these data can be factored into DWH oil spill recovery strategies.

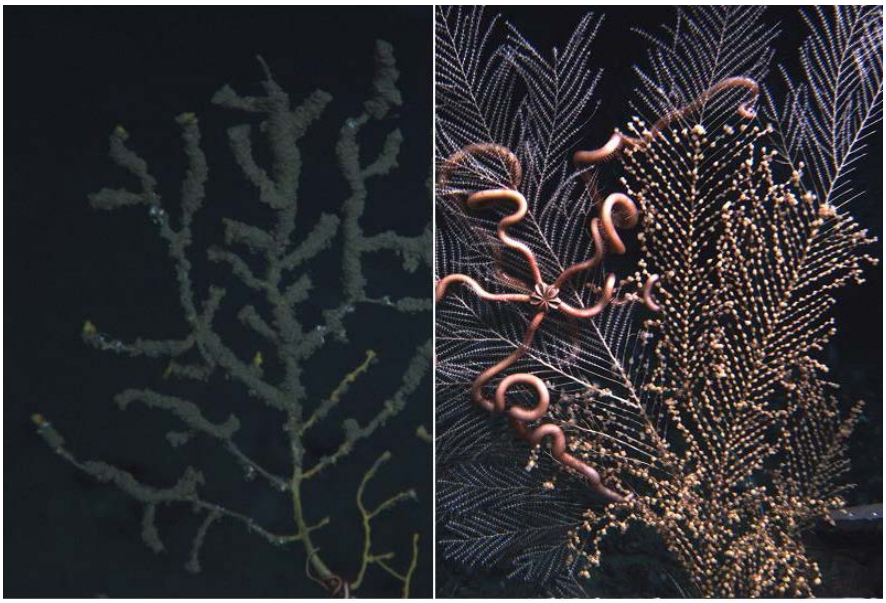

Figure 9. A wilting, dying coral covered with oil plume debris (left) compared to a normal coral with some dead skeletal material covered by typical secondary colonization (right). Photo credit: NOAA OER and BOEM

Management can help marine resources recover from oil spill injuries, and several priorities fall into this category. Protecting habitat, reducing fishing pressure and subsidizing the use of low-impact fishing gear are all examples of taking specific management action to offset losses resulting from oil spill injuries. Losses in this case may be the impaired ecological function of an injured benthic habitat (Figure 9). Protecting from incompatible activities a mosaic of hard and soft bottom communities similar in species composition and ecological characteristics to those injured by the DWH oil disaster (Table 3; O-8) could help compensate for the lost

services of the injured habitats. For example, the compromised ecological function of hard-bottom communities resulting from DWH oiling might be offset by protecting comparable unoiled, uninjured sites from mineral extraction or some types of high-impact fishing. Losses can also be the amount of biomass a particular species decreased as a result of the DWH oil spill. Lost biomass might be calculated as acute mortalities plus sublethal effects resulting in lower productivity (e.g., foregone offspring). Compensatory restoration can offset these losses by alleviating other factors responsible for population bottlenecks.[9] For example, providing free turtle excluder devices (Figure 10) and training to shrimp fishermen (Table 5; M-4) would lower bycatch mortality of sea turtle species injured by the DWH disaster, thereby contributing to the recovery of sea turtle populations impacted by that event.

Figure 10. Bycatch reduction devices could mean less unwanted catch of non-target species, fewer crushed shrimp, and faster sorting.

Workshop panelists also identified *in situ* habitat restoration as a priority. While the workshop largely focused on offshore resources, a few coastal or nearshore habitat types were included in the preliminary list of restoration options and ultimately were selected as priorities because they occur in both marine and

[9] Sperduto M, Powers SP, Donlan M. (2003). "Scaling restoration actions to achieve quantitative enhancement of loon, seaduck, and other seabird populations." *Marine Ecology Progress Series* 264:221–232.

coastal waters, provide critical nesting grounds for marine species, or support fisheries. These habitats are beaches (Table 5; M-01, M-10) used by nesting sea turtles and shorebirds, sea grasses (Table 3: O-03) that provide essential fish habitat in marine and coastal waters, and oyster reefs (Table 3; O-11) that support directed commercial oyster fisheries, recreational fisheries by concentrating fish biomass, and both commercial and recreational fisheries by providing feeding and nursery grounds for economically important fish species.

Panelists identified a few terrestrial restoration priorities that would directly benefit the marine environment by improving water quality (Table 3; O-18, O-20). In this category, for example, several panelists identified controlling land-based sources of pollutants (e.g., agricultural and golf course runoff, septic system discharges) as a priority needed to reduce hypoxia, harmful algal blooms and seagrass die-off inshore and nearshore. Experimental *in situ* restoration of deeper water corals was also identified as a priority along with complementary research and management efforts intended to promote coral reef regeneration (Table 3; O-04).

Some panelists suggested that instead of placing specific restoration options into one of four themes, the options should be organized by their ecological relationship to one another. They believed that the benefit of this approach was to illustrate how options address individual injuries while contributing to recovery of ecosystem function and condition at a larger scale. While the cosponsors agreed that restoration options should collectively represent an ecologically comprehensive and integrated portfolio that guides project selection and design with the greatest ecosystem benefits in mind, they concluded that the options, as presented, were consistent with how the NRDA Trustees match specific natural resource injuries and lost services with corresponding targeted restoration actions.

A majority of panelists identified Integrated Ecosystem Assessments (IEAs) as a priority for restoration. IEAs are science-based tools for ecosystem-based management and could help planners evaluate the impacts of restoration actions across the ecosystem.

Table 3. Marine restoration priorities for recovery of ocean habitats impacted by the DWH oil disaster as identified by the expert panel (O = alpha code for Ocean Habitats; numeric codes denote the order in which options were listed.)

Option Code	Option Description (Ocean Habitats)[10]	Number of panelists that identified as priority
O-16	Create a targeted monitoring program to understand current threats of existing oil and gas infrastructure and pollution to Gulf biota, and conduct a related chronic pollution evaluation	15

[10] For information on options' relevance to oil spill impacts and broader restoration, see Appendix V.

Option Code	Option Description (Ocean Habitats)[10]	Number of panelists that identified as priority
O-15	Develop and implement a permanently-funded, long-term Gulf-wide ecosystem modeling, monitoring, research and ocean observation program to provide the basis for responsive, informed management of marine natural resources, including those injured by the DWH disaster	15
O-10	Explore, identify, map and characterize ecologically and economically important habitat areas (e.g., productive, sensitive to impacts, oil and gas infrastructure or reserves) using best available technologies	14
O-08	Protect from incompatible uses the continental shelf and slope benthic "live bottom" habitats and adjacent "halo" of soft bottom areas important to foraging reef species, and mesophotic and deep sea coral communities	12
O-11	Re-establish, create, or protect oyster reefs focusing on production and non-production reefs in areas of historic abundance	11
O-12	Develop management and protection strategies that promote resiliency of marine ecosystems and their roles in maintaining sustainable fisheries, tourism, and coastal economies. Directly engage the Gulf of Mexico Fishery Management Council and Gulf States Marine Fisheries Commission to advance this concept within the scope of their charge	11
O-03	Protect existing and re-establish new seagrass beds in strategic areas combined with measures to facilitate successful recovery such as boating corridors to reduce propeller scarring, enforcement actions, better signage, and outreach measures	11
O-19	Conduct the science (including human dimensions) needed to evaluate system-wide marine protected areas, with studies of existing protected areas in the Gulf and their merits to serve as a foundation for additional restoration measures. Provide adequate funding for marine protected area enforcement, with particular emphasis on vessel monitoring systems (VMS) as a key enforcement option	11
O-20	Invest in public education and fund activities that recruit the public's help with restoration. In particular, public attention on reducing land-based sources of marine pollution is important to conserving both coastal and marine ecosystems	7
O-18	Reduce land based sources of pollution such as agricultural runoff and other land-based sources of pollution that affect nearshore and offshore water quality and contribute to harmful algal blooms and hypoxia	7
O-17	Protect ocean spawning habitat of bluefin tuna, blue marlin, whale sharks, mackerel, and other highly migratory pelagic species	6
O-06	Protect benthic soft bottom habitat from incompatible uses	4
O-04	Restore injured deepwater and mesophotic coral communities through research needed to understand coral reef connectivity and larval recruitment, through informed design and implementation of special marine managed areas, and through pilot habitat enhancement efforts that facilitate coral larval recruitment and regeneration of reef structure	4

Option Code	Option Description (Ocean Habitats)[10]	Number of panelists that identified as priority
O-14	Undertake studies to determine whether hydrodynamic steel shrimp trawl doors have a lower seafloor impact or footprint than traditional wooden trawl doors; if so, promote their use among fishermen operating offshore shrimp trawls	1
O-09	Restrict future harvest of *Sargassum* in the Gulf Economic Exclusive Zone	1
O-13	Implement programs to reduce or remove marine debris from sensitive ocean habitats (e.g., *Sargassum*, coral and "live bottom" reefs)	1

Table 4. Marine restoration priorities for recovery of fishery resources impacted by the DWH oil disaster as identified by the expert panel (F = alpha code for Fishery Resources; numeric codes denote the order in which options were listed.)

Option code	Option Description (Fishery Resources)	Number of panelists that identified as priority
F-01	Supplement existing and develop new fishery-independent surveys, including expansion to areas outside of existing survey range, to monitor changes in the status and dynamics of potentially impacted fish populations and inform management decisions and ecosystem models	16
F-27	Invest in field and lab research to better understand acute and chronic effects of oil and dispersants on fish and invertebrate species, including fish that are currently showing signs of stress. This work should identify a full range of sublethal biomarkers	15
F-16	Collect, compile and synthesize existing data, and identify and prioritize data needed to undertake ecosystem assessments in the Gulf of Mexico, followed by an Integrated Ecosystem Assessment (IEA) for informing restoration and natural resource management in the Gulf	13
F-14	Conduct more frequent stock assessments for potentially impacted finfish species that are overfished or near-overfished to inform adaptive management, including restoration from oil spill effects	13
F-05	Develop a large-scale fish DNA and smart tagging program to produce more accurate estimates of stock abundance for use in stock assessments, examine population connectivity within Gulf fishes and better understand species-specific resiliency	12
F-19	Increase the timeliness of recreational finfish catch estimates from the current reporting period of 2-month waves to 1-month waves or weekly waves for 10 years to help avoid overfishing and improve management of species possibly impacted by the DWH oil spill	12
F-13	Expand stock status assessments for federally managed species likely to be affected by oil and species whose population status is currently unknown	11

F-15	Identify and address gaps, such as the lack of spatial data at a fine scale and discard mortality rates, in fisheries dependent and independent data for federally managed species exposed to oil and/or dispersants, in an effort to assess and maintain population health	10
F-10	Expand observer coverage in Gulf shrimp trawl, shark gillnet, pelagic longline and reef fish fishery to quantify and characterize bycatch in order to inform bycatch minimization strategies and population health assessments	10
F-22	Upgrade the federally-permitted shrimp vessels electronic logbook (ELB) program to improve the precision of shrimp fishing effort and bycatch estimates of red snapper and other species of concern in the shrimp fishery; upgrades would include purchases of new ELB units and program enhancements necessary to expand ELB coverage in both the offshore and inshore shrimp fleets	4
F-06	Invest in research and development to reduce regulatory discards. As one specific example, assess eliminating the size limit coupled with other management measures or effective technological interventions. Any increase in catch resulting from no size limit might be achieved through closures of more spawning areas, avoidance of deeper areas, or other measures	4
F-04	Identify and mandate the use of alternatives to explosives in the removal or toppling of oil and gas platforms to minimize mortality of finfish	4
F-21	Improve unbiased recording of fish retained or discarded by implementing electronic video monitoring projects in the commercial reef fish fishery, followed by scaled-up implementation across the entire fleet	3
F-11	Pay reef fish fishermen not to fish during critical times or in sensitive areas to support the recovery of impacted reef fish species	2
F-12	Identify, develop, and promote the use of high performance shrimp bycatch reduction devices that reduce incidental take of non-target marine species while improving the efficiency of on-deck sorting	2
F-07	Explore management options to protect spawning stock biomass of bluefin tuna in the Gulf of Mexico (e.g., time/area fishing closures, reductions of pelagic long line effort, gear conversions, etc.)	2
F-25	Research the role of hatcheries in marine reef and pelagic fish biology, with emphasis on understanding larval/post larval growth and vulnerability to natural or anthropogenic factors	2

Table 5. Marine restoration priorities for recovery of wildlife populations impacted by the DWH oil disaster as identified by the expert panel (M = alpha code for Marine Wildlife; numeric codes denote the order in which options were listed.)

Option code	Option Description (Wildlife Populations)	Number of panelists that identified as priority
M-20	Assess the impacts of low-level exposure and breakdown of oil, oil products and chemical dispersants on wildlife to aid understanding of DWH impacts and restoration planning	15
M-23	Develop a large-scale innovative tagging program for sea turtles, seabirds and marine mammals to improve estimates of abundance, movement patterns, somatic growth, mortality and reproductive vital rates	15

Option code	Option Description (Wildlife Populations)	Number of panelists that identified as priority
M-19	Fund research and development for reducing wildlife impacts resulting from fisheries interactions (e.g., boat strikes, bycatch and depredation). Where appropriate, promote adoption of best available strategies	13
M-01	Facilitate recovery of sea turtle populations injured by DWH oil by protecting existing nesting beaches, reducing incompatible human activities such as artificial lighting, vehicular traffic, and beach armoring and by studying the effectiveness of nest relocation programs	13
M-21	Gather baseline information on abundance and distribution of sea birds, sea turtles and marine mammals	12
M-07	Expand and improve wildlife stranding networks and response capacity throughout the Gulf for collecting important biological information on impacted species, monitoring population health, and detecting animals in distress for rehabilitation and release back into the wild. Evaluate effectiveness of rehabilitation	12
M-14	Expand the observer coverage in Gulf shrimp trawl, shark gillnet, pelagic longline and reef fish fishery to quantify the extent to which marine mammals and sea turtles are taken	12
M-08	Support long-term live capture/release health assessment studies through relevant partnerships (NOAA, USFWS, private institutions, aquaria, NGOs) outside of or beyond NRDA in order to gather data necessary for evaluating health risk factors in marine mammals	11
M-22	Establish monitoring program to assess impacts of noise and seismic surveys on marine species and integrate acoustic measurement sensors into Gulf-wide observing system. Minimize direct, indirect and cumulative effects of noise on marine species survival, behavior and reproduction (e.g., ships, rig removal, sonar and seismic surveys) as informed by monitoring data	8
M-03	Upgrade the federally-permitted shrimp vessels electronic logbook (ELB) program to improve the precision of shrimp fishing effort and estimates of sea turtle bycatch in the shrimp fishery; upgrades should include purchases of new ELB units and program enhancements necessary to expand ELB coverage in both the offshore and inshore shrimp fleets	6
M-04	Provide new/improved/best available turtle excluder devices (TEDs) and TED training and installation to shrimp fishermen in state and federal waters. Measure compliance and enhance enforcement	5
M-26	Develop innovative monitoring tools (e.g., using marine mammals and sea turtles as monitoring sensor platforms)	5
M-25	Increase support for training students who will be the next generation of demographic modelers	5
M-24	Strategically buy out fisheries that have high sea turtle bycatch	5

Option code	Option Description (Wildlife Populations)	Number of panelists that identified as priority
M-11	Implement programs to reduce or remove persistent marine debris and prevent injury to wildlife species	3
M-16	Improve recording of wildlife-vessel interactions by implementing pilot electronic video monitoring projects in the commercial reef fish fishery, followed by scaled-up implementation across larger portion of fleet	3
M-10	Protect and expand existing bird nesting beaches and reduce incompatible human activities at those sites	2
M-15	Support Bureau of Ocean Energy Management studies to evaluate interaction of seabirds with oil and gas infrastructure (e.g., platforms) and impacts on bird mortalities or behavior. Conduct pilot studies to assess effectiveness of bird-friendly lighting on oil and gas platforms to reduce attraction of seabirds, especially tubenoses (petrels, shearwaters) and migratory birds; scale up as needed	1
M-13	Employ social attraction methods (decoys, vocalization recordings) to re-establish breeding colonies of marine birds; but to maximize success, ensure some proximity to source populations and access to nearby high quality foraging sites	0

Table 6. Marine restoration priorities for recovery of human uses impacted by the DWH oil disaster as identified by the expert panel (H = alpha code for Human Uses; numeric codes denote the order in which options were listed.)

Option code	Option Description (Human Uses)	Number of panelists that identified as priority
H-06	Conduct baseline and annual socioeconomic valuations of Gulf of Mexico fisheries (commercial, recreational); invest in standardization of socioeconomic fisheries data collection among Gulf states	15
H-12	Examine chronic socioeconomic impacts of DWH on commercial, recreational, and subsistence fisheries	13
H-07	Conduct a baseline assessment and establish benchmarks for a socioeconomic valuation of Gulf of Mexico nonuse ecosystem services (e.g., tourism, wildlife viewing, and the communities that depend on these activities)	13
H-10	Gather baseline data on subsistence uses of resources (e.g., fishing, way of life), using as a model for this activity the methods developed by the Division of Subsistence, Alaska Department of Fish and Game	10

Option code	Option Description (Human Uses)	Number of panelists that identified as priority
H-09	Fund overarching database management that includes the following: 1) sustaining integrated Gulf-wide Digital Atlas (NOAA ERMA), and 2) developing data management agreement between funding agencies and vendors that defines data management requirements and resolves propriety use issues; all restoration datasets should include FGDC-compliant metadata records and be archived in publicly-accessible repositories	9
H-04	Invest in expanded sampling and testing for seafood safety through appropriate existing state and federal programs, and increase outreach to the public about testing results, with the aim of improving the confidence of local, subsistence users in Gulf Coast communities	9
H-15	Create advisory groups and processes to promote transparency and access to information as well as to inform and influence restoration	9
H-14	Enhance and expand cooperative research programs with recreational and commercial fishermen	9
H-03	Carry out cooperative pilot projects to test feasibility and desirability of alternative recreational fisheries management strategies (e.g., fish tags, closed areas, bag limits, catch shares) that would offset lost access during DWH spill and allow greater flexibility in response to human-caused disasters	8
H-05	Undertake an assessment of oil platforms to understand their ecological, economic and social roles in the Gulf	7
H-08	Promote tourism by disseminating information on ecosystem services and natural amenities through innovative vehicles (e.g., interpretive centers, online resources, guides, and a roving museum). Promote outdoor recreation opportunities and programs for young people (e.g., enhance angling camps)	6
H-11	Increase public access to coastal and marine environment to increase public appreciation of restoration activities and value	6
H-01	Subsidize the use and training of fuel-efficient, cost-minimizing technologies to improve fisheries sustainability	3
H-02	Buy back federal fish permits from operators on a voluntary basis to help compensate such operators who wish to exit the fishery	3

Table 7. Marine restoration options organized by primary and compensatory type /subtype and cross-referenced with relevant natural resource or ecosystem service impacted by the Deepwater Horizon oil disaster. (Primary type = onsite, direct restoration; Compensatory type = offsite, indirect restoration)

Restoration Types[11]									
		Primary Restoration				Compensatory Restoration			
Impacted Resources and Ecosystem Services	Marine Resource or Service	On site Habitat Protection or Improvements	Restoration Research, Monitoring, Observation	Management	Public Outreach, Education	Off site Habitat Protection or Improvements	Restoration Research, Monitoring, Observation	Management	Public Outreach, Education
	Gulf Ecosystem	O-13, H-11			H-11	O-12, O-19	O-16, O-15, 0-10, O-19, F-16, F-24, M-22, H-09, H-05		O-20, H-15
	Water Column & Sediment	O-08, O-18, O-17, O-06, O-13				O-08, O-18, O-06	O-14		
	Sea grasses	O-03, O-13				O-03			
	Sargassum	O-13		O-09				O-09	M-11
	Nearshore Fish		H-04		H-04		F-01, F-27, F-14, F-05, F-19, F-15, F-10, F-24, F-03, F-12	F-19, F-12	H-04
	Offshore Fish	0-17	H-04	F-03, F-04, F-07, F-11, F-12, F-19	H-04	O-17	F-01, F-27, F-14, F-19, F-05, F-13, F-15, F-10, F-03, F-22, F-06, F-12, F-25	F-12, F-19, F-22, F-23, F-06, F-04, F-07, F-21, F-11, F-12, F-07	H-04
	Oysters	O-11	H-04		H-04	O-11	F-27		H-04
	Shrimp		H-04		H-04		F-01, F-27, F-22	M-03	F-22, M-04, H-04
	Crabs		H-04		H-04		F-01, F-27		H-04
	Corals, Shallow and Deep	O-04, O-08, O-13				O-04, O-08	O-04, O-14	F-04	
	Marine Mammals	M-11				M-11	M-20, M-23, M-19, M-21, M-07, M-14, M-08, M-22, M-26, M-25	F-04, M-16	M-07, M-11
	Sea Turtles	M-01, M-11		M-03, M-04, M-24		M-01, M-07, M-11	M-20, M-23, M-19, M-01, M-21, M-07, M-14, M-22, M-03, M-26, M-25	F-04, M-03, M-04, M-24, M-16	M-04, M-07, M-11
	Birds	M-11		M-10		M-10, M-11	M-15, M-19, M-20, M-23, M-21, M-07	M-10, M-15, M-13	M-07, M-11

[11] Please see Tables 3-6 for a full description of marine restoration options.

Restoration Types[11]									
		Primary Restoration				Compensatory Restoration			
	Commercial Fishing		H-04		H-04	O-12	O-14, F-01, F-27, F-14, F-05, F-15, F-24, F-06, M-03, H-06, H-12, H-14, H-05, H-01,	F-23, F-06, F-21, F-11, M-03, H-02	H-01, H-04, H-14, H-15
	Recreational Fishing		H-04		H-04		F-01, F-27, F-14, F-05, F-19, F-15, F-06, H-06, H-12, H-14, H-05,	F-06, H-02, H-03	H-03, H-04, H-14, H-15
	Subsistence		H-04		H-04	O-12	F-01, F-27, F-14, F-05, H-12, H-10, H-04		H-04, H-15
	Ecotourism (e.g., wildlife viewing)	H-011			H-11	O-12, H-11	H-07, H-05	H-08	H-08, H-11

Principles of Restoration Science

Achieving restoration objectives will depend in part on setting up the restoration program for success. The cosponsors shared with workshop panelists draft principles for establishing and maintaining an effective restoration science program. Panelists provided input and feedback, which the cosponsors used to produce a final suite of principles. These principles are not exhaustive, but the cosponsors believe they represent the most important issues and best practices that a Deepwater Horizon Oil Spill Restoration Program or similar Gulfwide restoration program should incorporate for best results.

A Gulf of Mexico restoration program should:

- Be based on an understanding of the ecosystem, which is reflected in a descriptive model and updated periodically based on results of monitoring and research activities;
- Embrace science to support, guide, and evaluate projects, but also recognize that increased knowledge can be itself a form of restoration and recovery if incorporated into management;
- Include a commitment to gather necessary data to advance understanding of the ecosystem, including basic processes, and to inform restoration;
- Support an integrated long-term monitoring, research, observing and modeling program;
- Integrate restoration project planning and implementation within and across programs (DWH NRDA restoration projects, GCERTF) to avoid duplication, promote ecological balance in project portfolio, maximize efficiencies and support common goals;
- In designing restoration projects, take into account and monitor climate change (especially temperature and pH) and other types of environmental change and degradation that impact ecosystem resilience: for example, pollution, overfishing, habitat destruction and invasive species;
- Embrace a Gulfwide ecosystem approach, including interdisciplinary studies and Integrated Ecosystem Assessments, based on an overarching regional science plan that guides the types of investments that should be made in monitoring, research, observing, and modeling;
- Commit to an on-going synthesis of results and communication of those results for the scientific community, policy-makers, and the public. This effort should include an annual Gulfwide restoration science symposium, similar to the Alaska marine science symposium, and building upon the Gulf of Mexico Research Initiative (GoMRI) annual science meetings;
- Rely on independent peer review at both program and project levels, including proposals, reports, plans, and publications;
- Work closely with Gulf regional planning and management organizations to anticipate, coordinate, and expedite project environmental compliance and research, including permitting, for project implementation and timeliness in data collection;

- Apply lessons learned from the DWH oil spill to future NRDA activities and other assessment programs to promote improved baseline information and more rapid acquisition of data on natural resource damage. This application is critical given the increasing trend in ultra-deepwater drilling;
- Maintain data in ways that facilitate access and appropriate uses by the scientific community, resource managers, and public, consistent with national guidelines and national metadata and archive standards. Potential models or outlets for data access and management are the National Coastal Data Development Center, GoMRI and Gulf of Mexico Alliance data management programs;
- Sustain monitoring required for adaptive management to inform and improve project design and resource management;
- Rely on periodic open requests for proposals; the results and performance of prior projects should inform the content of these RFPs; and
- Promote public awareness, public accountability and transparency, and meaningful public participation. (Note that creating advisory groups and processes to promote transparency and access to information for informing and influencing restoration was selected as a priority by a majority of panelists, Table 6, H-15).

Conclusions and Recommendations

The DWH disaster was the largest, unintentional marine discharge of hydrocarbons in history, impacting a large area of the offshore waters in the Gulf of Mexico and the coasts of the five states bordering the Gulf. Trustees continue to account for impacts of the oil spill on the marine environment, even though a full accounting of injuries may be impossible. In spite of this, acute wildlife mortalities and disaster-related fishery closures, combined with results from NRDA and published non-NRDA studies, provide strong evidence that the disaster resulted in injuries to and lost services of marine resources.

Sea turtles, seabirds, bottlenose dolphins, deep sea corals, reef fish (e.g., red snapper) and oysters that are oiled and dead or sick in the northern central Gulf provide some of the strongest indicators to date that the disaster resulted in a variety of natural resource injuries. Closed recreational and commercial fishing grounds and negative perceptions of the condition of local seafood are clear examples of impacted human uses. In addition, the disaster may have compounded chronic sources of stress on this large marine ecosystem, further compromising crucial ecosystem services such as food web dynamics, fisheries, wildlife viewing and other passive and consumptive uses beneficial to society.

A growing number of marine species and habitats, plus the ecosystem services and human uses they support, warrant restoration attention and funding to achieve recovery. The cosponsors held this workshop to explore and identify a suite of restoration priorities that should be considered and evaluated as candidate projects to accelerate recovery of ocean habitats, fishery resources, marine wildlife and human uses impacted by the disaster.

The workshop panelists identified a cross-section of approaches for restoring marine resources that fall into the primary and/or compensatory restoration categories. Approaches for direct, onsite restoration of open-ocean, marine resources (e.g., primary) are available mainly as protection or management measures. A large number of restorative actions considered scientific in nature qualify as compensatory—as distinct from primary—although they could justifiably be primary because determining recovery or detecting delayed impacts is only possible through on-going science.

The cosponsors offer the following recommendations to restoration planners, particularly to the DWH Natural Resource Trustees, in the hope that a significant portion of NRDA or RESTORE Act funds will be dedicated to the recovery of marine species, habitats, ecosystem services and human uses. As one important measure of public support for marine restoration, the Trustees received thousands of public scoping comments for the DWH oil spill Programmatic Environmental Impact Statement (PEIS), encouraging them to include restoration options for offshore resources and marine wildlife. The list of prioritized restoration options coming out of this workshop serves as a guide for making the sound investments in marine restoration, with emphasis on offshore resources.

- The cosponsors encourage the Trustees to nominate and fund scientifically sound marine restoration projects that address DWH oil spill injuries to marine resources, and related lost services or human uses of those resources. Marine restoration projects should have an offshore focus to complement coastal and nearshore restoration projects. That is, a restoration program should fund projects along the ecological spectrum and spatial scale of injury, from the coast to offshore benthic, midwater, and pelagic environments.
- The cosponsors encourage the Trustees to approach marine restoration with an expanded set of restoration alternatives and actions under NRDA that are tailored to the complex nature, offshore origin and ecosystem-wide scale of the disaster. This enhanced NRDA toolbox should include marine monitoring, research and observation, and resource management actions as effective forms of restoration, even if primarily compensatory in nature. Gaining a better understanding of the delayed or lingering impacts from the disaster on the Gulf ecosystem and how these interact with pre-existing, chronic stressors are important priorities for Gulf restoration.
    - The cosponsors encourage the trustees to apply early restoration funding as well as funds secured through resolution of litigation and other sources to the types of scientific activities, management measures and habitat improvements described in the list of priorities for ocean habitats (Table 3), fishery resources (Table 4), marine wildlife (Table 5), and human uses (Table 6).

In order to be most effective, it is appropriate to dedicate a portion of funds remaining from NRDA early restoration and/or resolution of legal claims to support a robust and long-term Gulfwide monitoring, research and observation program that supplements project-level monitoring required under NRDA. Responsible parties should receive credit for the costs of the science this program generates. A program of this scope and scale is necessary to detect latent, chronic or sublethal injuries and track the recovery of resources and lost uses across space, time and jurisdictional boundaries. This program could also contribute to the supporting science needed by the U.S. government to pursue future damage claims against responsible parties for environmental harms not evident at the time legal claims are resolved.

APPENDIX I. Known and potential impacts of the BP Deepwater Horizon oil disaster[12]

Resource	Impact	Source
Sea Turtles	April 30, 2010 to February 15, 2011: • 609 sea turtles recovered dead • 537 recovered alive • Of these turtles, 481 (dead) and 328 (live) were Kemp's ridleys. • 274 sea turtle nests relocated (relocation ended Aug. 19, 2010)	http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm Last update 15 August 2011
Birds	April 2010 to May 2011: • 7258 birds collected • 2121 visibly oiled and dead (either dead at collection or died later) • 512 visibly oiled and alive	US Fish and Wildlife Service Deepwater Horizon Bird Impact Data. DOI-ERDC NRDA Database. 12 May 2011. Retrieved from http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf
Oysters	Oysters in Louisiana suffered high mortality rates on both public and private grounds in Brenton Sound and Barataria Basin.[1] Some sites had 100% mortality of seed and sack size oysters.[2] Spat settlement was reduced or absent in some areas.[1]	1. Banks, Patrick. 2010. Comprehensive report of the 2010 oyster mortality study in Brenton and Barataria Basins – May 2011. Louisiana Department of Wildlife and Fisheries. 2. Louisiana Department of Wildlife and Fisheries. 2010. Oyster stock assessment report of the public oyster areas in Louisiana seed grounds and seed reservations.
Gulf Killifish (Fundulus grandis)	• Increased expression of the CYP1A protein, a common biomarker for exposure to select polycyclic aromatic hydrocarbons (PAHs).[1, 2] • Damage to gill tissue.[2] • Delayed hatch in exposed embryos.[2]	1. Whitehead, A., B. Dubansky, C. Bodinier, T. Garcia, S. Miles, C. Pilley, V. Raghunathan, J. Roach, N. Walker, R.B. Walter, C.D. Rice, and F. Galvez (2011). Genomic and physiological footprint of the Deepwater Horizon oil spill on resident marsh fishes. Proceedings of the National Academy of Sciences of the United States of America, doi/10.1073/pnas.1109545108 2. Whitehead, Andrew. 2011. BP Oil Spill Principal Investigators Conference. St. Petersburg, FL.
Finfish	Researchers documented fin rot, lesions, and parasites on fish around the Gulf. Areas with high prevalence of lesions seem to overlap the NOAA oil footprint. Frequency of	1. Murawski, Steve. 2011. Deepwater Horizon Oil Spill Principal Investigator Conference. St. Petersburg, FL. 2. Cowan, Jim. 2011. Personal

[12] Compiled by Ocean Conservancy

	occurrence and background level of occurrence being determined.	communication.
Bluefin Tuna (Thunnus thynnus)	On a weekly basis, about 5% of bluefin tuna larval are predicted to have been affected by surface oil, and about 11% by contaminated water.[1, 2] There was an estimated 20% reduction in the 2010 larval year class, which is estimated to result in less than a 4% reduction in spawning biomass.[1]	1. Atlantic Bluefin Tuna Status Review Team. 2011. Status review report of Atlantic bluefin tuna (Thunnus thynnus). Report to National Marine Fisheries Service, Northeast Regional Office. 22 March 2011: p. 49 - 51. 2. Muhling, B.A., et al. 2012. Overlap between Atlantic bluefin tuna spawning grounds and observed Deepwater Horizon surface oil in the northern Gulf of Mexico. Marine Pollution Bulletin, doi:10.1016/j.marpolbul.2012.01.034
Whale shark (Rhincodon typus)	Potential shift in distribution and/or abundance in whale sharks during 2011. Fewer sightings of whale sharks in the Gulf during 2011 than expected from 2003 -2009 trend. More than one third of 2002 - 2009 sightings overlapped 2010 oil footprint.	Hoffmayer, Eric. 2011. Deepwater Horizon Oil Spill Principal Investigator Conference. St. Petersburg, FL.
Cetaceans	• Since Feb. 2010, there has been a cetacean unusual mortality event in the Gulf. In total, 714 cetaceans have stranded (95% dead). The majority of these have been bottlenose dolphins.[1] • 600 cetaceans have stranded during and after the Deepwater Horizon response (April 30, 2010 to April 1, 2012).[1] • Early results from 32 dolphins tested in Barataria Bay show that many of these dolphins are underweight, anemic, have low blood sugar, and/or have signs of liver and lung disease. About half have low levels of hormones that help in stress response, metabolism and immune function. Many are not expected to survive.[2, 3] • Sperm whale tagging study underway. Some whale locations overlapped oil footprint. Whales may absorb impacts, but prey source, squid, may have been impacted as well.[4] • Passive acoustic monitoring results indicate that sperm whales activity decreased at	1. NOAA. “2010-2012 Cetacean unusual mortality event in the Northern Gulf of Mexico”. 1 April 2012. Retrieved from http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm 2. NOAA. “Some Gulf dolphins severely ill, says study by NOAA and partners”. 4 April 2012. Retrieved from http://response.restoration.noaa.gov/about/media/some-gulf-dolphins-severely-ill-says-study-noaa-and-partners.html 3. NOAA. 23 March 2012. Email Media Advisory: “Study by NOAA partners shows some Gulf dolphins severely ill.” 4. Mate, Bruce. 2011. Personal communication. 5. Ackleh, A.S., et al. 2012. Assessing the Deepwater Horizon oil spill impact on marine mammal population through acoustics: Endangered sperm whales. Journal of Acoustical Society of America. Volume 131: No. 3.

	stations nine miles from DWH well.[5]	
Sargassum	Patches of *Sargassum* had visible oiling and tar balls. Burned during cleanup.	Hernandez, F. 2011. Deepwater Horizon Oil Spill Principal Investigator Conference. St. Petersburg, FL.
Deepsea Coral	Lophelia Cruise: • November 2010, deepsea corals 11km southwest of wellhead covered in brown flocculent material.1 Location of corals overlapped path of previously documented plume.[2] • December 2010, same corals dead or dying. Bare skeletons exposed and coral showing tissue damage.[1] • The material on corals2 and the sediment1 at the base of the corals matched biomarker for Macondo Oil.	1. White, Helen. 2011. Deepwater Horizon Oil Spill Principal Investigator Conference. St. Petersburg, FL. 2. White, H.K., et al. 2012. Impact of the Deepwater Horizon oil spill on deep-water coral community in the Gulf of Mexico. Proceedings of the National Academy of Sciences. Retrieved from www.pnas.org/cgi/doi/10.1073/pnas.1118029109
Foraminifera	Deformed foraminifera documented in 8 out of 42 benthic samples (19%). NOTE: small sample size	Flower, Benjamin. 2011. Deepwater Horizon Oil Spill Principal Investigator Conference. St. Petersburg, FL.
Zooplankton	Zooplankton accumulated oil derived PAHs from the BP deepwater horizon disaster.	Mitra, S., et al. 2012. Macondo-1 well oil-derived polycyclic aromatic hydrocarbons in mesozooplankton from the Northern Gulf of Mexico, Geophysical Research Letters, 39, L01605, doi:10.1029/2011GL049505.
Insects and spiders	Terrestrial arthropod density at oiled sites was suppressed by 50% compared to control sites. Population appears to have rebounded at some sites after one year.[1] Another unpublished study also shows impact to insects and spiders, but slow recovery in LA marshes.[2]	1. McCall, B and Pennings, C. 2012. Disturbance and recovery of salt marsh arthropod communities following BP Deepwater Horizon oil spill. PLoSOne, Volume 7:3. 2. Beaumont, P. (31 March 2012) Gulf's dolphins pay heavy price for Deepwater oil spill. Guardian, UK.
Benthic soft sediment	Upper layer of sediment was oil rich down to 9cm in February 2011.	1. Flower, Benjamin. 2011. Deepwater Horizon Oil Spill Principal Investigator Conference. St. Petersburg, FL.
Shoreline	• 1053 linear miles of shoreline oiled.[1] • Tarballs found with elevated numbers of Vibrio vulnificus on beaches in MS and AL. V. vulnificus is a bacteria that can cause illness in humans.[2] • Changes in community structure of microbial eukaryotes. Pre-spill assemblages of Metazoa shifted to dominantly fungal communities post-spill.[3]	1. NRDA by the numbers factsheet. 201 Retrieved from http://www.gulfspillrestoration.noaa.gov/wp-content/uploads/2011/02/NRDA_by_the_Numbers_1_11_FINAL.pdf 2. Tao, Z., Bullard, S. and Arias, C. 2011. High numbers of Vibrio vulnificus in tar balls collected from oiled areas of the North-Central gulf of Mexico following the 2010 BP Deepwater Horizon Oil Spill. EcoHealth, DOI:

		10.1007/s10393-011-0720-z 3. Bik, H.M., K.M. Halanych, J. Sharma, W.K. Thomas. 2012. Dramatic shifts in benthic microbial eukaryote communities following the Deepwater Horizon oil spill. PLoS ONE 7(6): e38550. doi:10.1371/journal.pone.0038550
Salt Marsh	• A total of 463.8 miles of marsh were oiled around the Gulf: 436.2mi in LA, 21.5mi in MS and 6.1mi in AL.[1] • 400 – 435 km^2 of marsh showing signs of stress post-oil in LA. Rainfall was normal and no storm events occurred in study area.[2] • Marsh erosion amplified in oiled marshes in Louisiana.[3]	1. William P Benson, Filed Specialist, 8th Coast Guard District, Gulf Coast Incident Management Team. 11 Jul. 2011. Personal communication. 2. Mishra, D.R., et al. 2012. Post-spill state of the marsh: Remote estimation of the ecological impact of the Gulf of Mexico oil spill on Louisiana salt marshes. Remote Sensing of the Environment, 118: 176-185. 3. Silliman, B.R. 2012. Degradation and resilience in Louisiana salt marshes after the BP-Deepwater Horizon oil spill. PNAS. Published online before print DOI: 10.1073/pnas.1204922109
Human Use	• The federal fishery closure included up to 88,522mi^2, or about 37 percent, of federal waters in the northern and eastern Gulf. • State fishing grounds in LA, MS, AL and FL were closed for different durations, affecting commercial, recreational, and subsistence fishermen. • May-August of 2010, the number of for-hire fishing trips in MS, AL, LA and W. FL decreased 98, 80, 60 and 33 percent, respectively, compared to the 10 year average in each of those states. • May-August 2010, the number of angler trips in personal or rented boats declined between 13 to 23 percent from the 10-year average in AL, LA and MS. In W. FL the effort was redirected.	1.http://sero.nmfs.noaa.gov/ClosureSizeandPercentCoverage.htm 2. Ocean Conservancy. 2011. Restoring the Gulf of Mexico: A framework for ecosystem restoration in the Gulf of Mexico. (Original citation: Unpublished data from the Marine Recreational Fishery Statistics Survey Program provided by the Gulf States Marine Fisheries Commission to Ocean Conservancy, 2011)

APPENDIX II: Gulf of Mexico Research Initiative

The Gulf of Mexico Research Initiative (http://www.gomri.org) received a commitment of $500 million over 10 years from BP to fund research related to the DWH oil disaster. GOMRI focuses on independent research by academic partners designed to study impacts of the oil spill and its associated response on the environment and public health in the Gulf of Mexico. Year 1 funding supported five institutions to establish critical baseline data as the foundation for subsequent research, including:

- $5 million to Louisiana State University
- $10 million to the Florida Institute of Oceanography hosted by the University of South Florida
- $10 million to the Northern Gulf Institute, a consortium led by Mississippi State University
- $5 million to the Alabama Marine Environmental Sciences Consortium
- $10 million to the National Institutes of Health

In June 2011, RFP II was issued for $1.5 million in grants to ensure continuity of Year 1 observations. In August 2011, RFP I resulted in awards to eight research consortia, all with lead institutions in Gulf states, totaling $112.5 million over three years (see http://www.gulfresearchinitiative.org/request-for-proposals/ for details of the RFP process and awards). The major research themes addressed in RFP-I included:

1. Physical distribution, dispersion, and dilution of petroleum (oil and gas), its constituents, and associated contaminants (e.g., dispersants) under the action of physical oceanographic processes, air–sea interactions, and tropical storms
2. Chemical evolution and biological degradation of the petroleum/dispersant systems and subsequent interaction with coastal, open-ocean, and deep-water ecosystems
3. Environmental effects of the petroleum/dispersant system on the sea floor, water column, coastal waters, beach sediments, wetlands, marshes, and organisms; and the science of ecosystem recovery
4. Technology developments for improved response, mitigation, detection, characterization, and remediation associated with oil spills and gas releases
5. Fundamental scientific research integrating results from the other four themes in the context of public health

Issued in April 2012 (awards later in 2012), RFP II will fund $22.5 million in research over three years for smaller, principal investigator-led research proposals, also addressing the above themes. The major objectives of these grants are to promote understanding that will inform restoration, but not specific actions to restore marine ecosystems.

APPENDIX III: Workshop participants

MARINE RESTORATION WORKSHOP **APRIL 24-25, 2012, USF College of Marine Science, St. Petersburg, FL** **MEETING ATTENDEES**		
Moderators/Coordinators		
Chris Robbins*	Ocean Conservancy	crobbins@oceanconservancy.org
Andy Shepard*	Gulf of Mexico University Research Collaborative	sheparda@usf.edu
Dr. Dennis Takahashi-Kelso	Ocean Conservancy	dkelso@oceanconservancy.org
Presenters		
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Dr. Pete Peterson	UNC-Chapel Hill	cpeters@email.unc.edu
Stan Senner**	Ocean Conservancy	ssenner@oceanconservancy.org
Dr. Bob Spies**	Applied Marine Science	spies.b@gmail.com
Panelists		
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Vicki Cornish	Marine Mammal Commission	vcornish@mmc.gov
Jason DeLaCruz	Gulf of Mexico Reef Fish Shareholders' Alliance (Commercial Fisherman)	salty398@aol.com
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Dr. Steve Murawski	University of South Florida	smurawski@usf.edu

MARINE RESTORATION WORKSHOP APRIL 24-25, 2012, USF College of Marine Science, St. Petersburg, FL MEETING ATTENDEES		
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MARINE RESTORATION WORKSHOP APRIL 24-25, 2012, USF College of Marine Science, St. Petersburg, FL MEETING ATTENDEES		
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* - also presenters; ** - also panelists

APPENDIX IV: Ranking methodology of marine restoration options

Pre-workshop preparation

Panelists and observers received an agenda,[13] a preliminary list of marine restoration options and preparation instructions before the workshop. The list of marine restoration options was compiled and adapted from various sources, including: Sea Grant Strategic Plans from each of the Gulf states, the Regional Restoration Strategy prepared by the GCERTF, the Gulf of Mexico Fishery Management Council 5-Year Research Plan and DWH restoration project concepts submitted by the public through NOAA's web portal.[14] Options were defined as "actionable measures that could take the form of habitat improvements, investments in science, data collection and technology, changes in fisheries management, marine pollution improvements or adaptive management measures needed to help a natural resource recover from the DWH oil spill or other stressors." Panelists were asked to review the preliminary list and come to the workshop prepared to make changes to the list and to offer other ideas.

Background Plenary

Day one of the marine restoration workshop provided background presentations[15] on the purpose and context of the workshop and covered: (1) the goals of the Natural Resource Damage Assessment (NRDA) under the Oil Pollution Act of 1990, the types of oil spill restoration as defined under NRDA, and examples of creative approaches to restoration of marine resources; (2) the role of science in ecosystem restoration, using examples from the *Exxon Valdez* oil spill restoration process; (3) a summary of known and potential DWH oil spill impacts; and (4) an overview of the Gulf of Mexico Regional Ecosystem Restoration Strategy prepared by the GCERTF, highlighting the strategy's recommendations for restoring living coastal and marine resources and priorities for funding science within an adaptive management framework.

Discussion, revision and ranking of restoration options

Moderators led panelists through a discussion of marine restoration options organized into four themes: ocean habitats, fishery resources, marine wildlife and human uses. For each theme, they allotted approximately 1.5 hours, during which panelists modified, deleted, added or combined options. Observers were given the opportunity to ask questions and make suggestions. Staff (on a projected screen) and panelists (on printed sheets) recorded changes to the options next to option descriptions on prepared worksheets. Each option was assigned an alphanumeric code (alpha codes: O = ocean, M = marine wildlife, F = fisheries, H = human uses; numeric codes = ranks) so that panelists could refer

[13] http://www.marine.usf.edu/gomurc/docs/Agenda-4-13-12-final.pdf
[14] http://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/view-submitted-projects/
[15] Presentations available upon request.

back to the detailed descriptions during the ranking process. At the end of each theme discussion, panelists scored the options based on relevance and suitability for restoration on a separate worksheet (see page 54 for an example). Panelists anonymously completed four ranking worksheets, one for each theme.

Panelists evaluated each option with respect to four threshold and seven supplemental criteria (as described on page 53). Threshold criteria were adapted from the Oil Pollution Act (OPA) regulations and were used to indicate the degree to which an option would likely qualify for selection under the act.[16] These criteria included:

- Nexus to Injury
- Feasibility
- Likelihood of success
- Cost Effectiveness

Panelists scored each option for each threshold criterion, by choosing either positive (yes, met criteria) or negative (no, did not meet criteria).

Supplemental criteria were adapted from OPA regulations and from Section 2.3 in *Restoring the Gulf of Mexico: A Framework for Ecosystem Restoration in the Gulf of Mexico*[17], and were used to gauge the suitability of each option according to a broader suite of considerations. These included:

- Systemic issues addressed
- Benefits to multiple resources
- Implementation impacts
- Diversity, balance
- Benefits to people
- Immediacy of need
- Public support

Panelists used the following numeric scale to rank option suitability for each supplemental criterion: 3 – Fits very well, 2 – Fits moderately well, 1 – Fits, but a stretch (i.e., only minimally), 0 – Does not fit.

Each option received three scores determined across panelists:

- the percent positive threshold score, calculated using the equation
  - %Positive = Number positive responses/Total number of responses
- the cumulative score for all 7 supplemental criteria for each option
- the mean supplemental criterion score calculated using the equation
  - Mean = Sum of supplemental criterion scores/total number of scorers and a composite score calculated using the equation
  - Composite = mean supplemental score x % positive threshold criteria responses. (Note: Composite scores were calculated and circulated after the workshop.)

[16] 15 C.F.R. 990.54
[17] http://www.oceanconservancy.org/our-work/assets/pdf/oc-gulfrestoration-dec15.pdf

Overview of ranking approach

Seventeen panelists participated in ranking the options, but not all panelists ranked every option. Seventeen was the highest number of panelists who ranked a given option, and nine was the fewest. Panelists ranked a total of 69 marine restoration options in four themes: ocean habitats (16), fishery resources (20), wildlife (19) and human uses (14). The 69 options included actions in the form of habitat improvements, investments in research, monitoring, data collection and technology, changes in fisheries management, marine pollution abatement or other types of adaptive management needed to help a natural resource recover from DWH oil spill injuries or historical stressors. Tables 3-6 show the option descriptions and the number of panelists that considered each option a priority.[18] While the options listed are in order from highest to lowest priority, all options in Tables 3-6 received panelist review and were considered of sufficient importance to include in the final list of priorities.

Establishing marine restoration priorities

On day two, panelists were given the results of the ranking exercise. At this time, panelists and observers were also given the opportunity to refine the option descriptions and clarify which options should be merged. They were then asked to review the cumulative scores and identify their top 5 to 10 priorities using the rankings as a preliminary guide. To help prioritize the options, panelists asked the cosponsors: (1) to clarify the relevance of options to DWH oil spill impacts, specifically nexus to injury; and (2) to help them understand the importance of the supplemental ranking scores relative to the threshold criteria scores. To address the latter, the cosponsors calculated composite scores (see above) for each option.

Within a week after the workshop, panelists received a matrix that included all panelist-recommended changes to options with updated composite scores, clarification on the nexus of injury for each option (Appendix V), and information on the relevance of each option to historical degradation (Appendix V). Two weeks after the workshop, panelists were asked to select their 10 highest priority options per theme, giving consideration to rankings sorted by composite score, but being free to choose any option regardless of ranking. These selections (as denoted by an ‘X’) were counted for each option, and later used to sort options as priorities.

Threshold criteria (as presented to experts at workshop)

For each listed option, Please check the ‘Yes’ or ‘No’ box indicating whether or not the option meets the relevant threshold criterion.

[18] A complete Excel workbook of panelist scores and ranks by theme is located at http://www.gomurc.org/ocworkshop.asp.

Nexus to injury

The option is linked to a particular injury or lost service resulting from DWH oil spill, such that it would benefit recovery of that resource, provide an alternative equivalent resource, or restore access to or use of the resource.

Feasible

The option is technically possible and can realistically be implemented within a reasonable timeframe.

Likely to succeed

The option is likely to result in a successful outcome and measurably contribute (even if indirectly) at an appropriate scale to the recovery of a natural resource or service over time.

Cost effective

The cost to carry out the option is reasonable relative to the benefits.

Supplemental criteria:

For each listed option, mark how well the project conforms to each of the following criteria using this scale:

3 – Fits very well
2 – Fits moderately well
1 – Fits, but a stretch
0 – Does not fit

Addresses systemic issues

The option addresses systemic, historical ecosystem degradation but facilitates recovery of injured natural resources and lost services.

Benefits multiple resources

The option benefits more than one natural resource and/or ecosystem service or human use.

Implementation impacts

The option is not expected to have harmful impacts on non-target resources and services including other resources and services injured by the spill.

Adds Diversity, Balance

The option helps ensure the marine habitats, species, and human uses addressed in the overall list of marine restoration options are ecologically or thematically diverse and balanced in scope.

Benefit to people

The option restores natural resources or ecosystem services that have economic, cultural or subsistence value.

Immediacy of need

The need to implement an option is time sensitive such that the rate of recovery of a natural resource or service is dependent on taking action sooner than later.

Public Support

The option is likely to be viewed favorably by the public or has already received support in the community.

Indicating Top Priority Options

Total scores will be used to group restoration options into tiers of importance. The participants will discuss which options fall into the ‘top priority’ tier. The addition of other tiers (e.g., needs more info, not appropriate, etc.) to further categorize options can be decided at the workshop.

APPENDIX IV (CONT.): Example of Ranking Worksheet

Options that Facilitate the Recovery of Human Uses															
Option code	**Threshold criteria**								**Supplemental criteria**						
	Please check the 'Yes' or 'No' box indicating whether or not the option meets the relevant threshold criterion.								For each listed option, mark how well the project conforms to each of the following criteria using this scale: 3 – Fits very well 2 – Fits moderately well 1 – Fits, but a stretch 0 – Does not fit						
	Nexus to Injury		Feasible		Likely to succeed		Cost Effective		Addresses systemic issues	Benefits multiple resources	Implementation impacts	Adds Diversity, Balance	Benefit to people	Immediacy of need	Public support
	Yes	No	Yes	No	Yes	No	Yes	No							
H1															
H2															
H3															
H4															
H5															
H6															
H7															
H8															
H9															

Options that Facilitate the Recovery of Human Uses

Option code	Threshold criteria								Supplemental criteria						
	Please check the 'Yes' or 'No' box indicating whether or not the option meets the relevant threshold criterion.								For each listed option, mark how well the project conforms to each of the following criteria using this scale: 3 – Fits very well 2 – Fits moderately well 1 – Fits, but a stretch 0 – Does not fit						
	Nexus to Injury		Feasible		Likely to succeed		Cost Effective		Addresses systemic issues	Benefits multiple resources	Implementation impacts	Adds Diversity, Balance	Benefit to people	Immediacy of need	Public support
	Yes	No	Yes	No	Yes	No	Yes	No							
H10															
H11															
H12															
H13															
H14															
H15															
H16															

APPENDIX V: Additional information on marine restoration options

Ocean Habitats			
Option Code	**Notes**	**Nexus to Injury[19]**	**Relevance to Historical Issues and Broader Restoration**
O-16		Benthic and pelagic habitats and species, especially marine mammals such as dolphins and sperm whales and long-lived coral communities	Continuing or new oil and has development, particularly in deep water, generates ship traffic and noise (seismic surveys), impacts sensitive bottom habitats through drilling and oil pipeline development and increases risk of oil and gas leaks to coastal and offshore environments.
O-15	This program should support and complement science developed or needed through an Integrated Ecosystem Assessment (IEA) for the Gulf region. Both the endowed monitoring, research and ocean observation program and IEA should engage stakeholders in collaborative efforts to design ecosystem-based management approaches that facilitate adaptive management of natural resources.	Documenting delayed, chronic or sublethal impacts from the oil spill through monitoring and research is critical to developing effective restoration and management approaches; building a better baseline of biological data will improve responses to future disasters and economically disruptive episodic events.	Improving investments in applied fisheries science can lead to better management; improved ocean observation can improve forecasting of storms, red tides, productivity, etc.
O-10	Scientific characterization should define habitat-fish associations used in fish population assessments. Maps should identify habitats of similar type, quality and ecological value to those that were known to be oiled for assessment and potential restoration attention.	Offshore habitats or their associated fish species exposed to oil	Location of rare, sensitive or productive habitats in relation to human activities such as oil/gas development and associated infrastructure and bottom trawling
O-08	Protections should be driven by research based on more extensive and informative habitat maps, and improved understanding of deep sea coral life history and population dynamics	Deep sea corals confirmed oiled in vicinity of wellhead; hard bottom habitats exposed to oil and dispersants over a wide area.	Hard bottom “live” habitas impacted by some types of fishing gear, extraction of substrate for beach nourishment and resulting sedimentation.
O-11		Oyster reefs injured by	Distribution and abundance of

[19] Based on research findings or relevance of the option to DWH oil spill impact and recovery.

Ocean Habitats			
Option Code	**Notes**	**Nexus to Injury[19]**	**Relevance to Historical Issues and Broader Restoration**
		releases of freshwater used to repel oil from estuaries or exposed directly to oil or chemical dispersants.	oyster reefs is smaller today due to historical fishing methods/pressure, excessive sedimentation, and pollution
O-12		Economically important species such as turtles, dolphins, whales and birds popular among tourists or finfish species attracting anglers have been exposed to or injured by oil	Bycatch, overfishing, vessel strikes, episodic disease outbreaks (e.g, red tide), hypoxia, invasives and other stressors affect health of wildlife and fishery species and weaken resiliency to recover
O-03		Sea grass beds injured by oil response efforts (e.g., boat anchoring, boom placement and retrieval)	Some types of fishing gear (e.g., crab traps), prop scarring, oil spills, sedimentation from dredging and other water quality issues
O-19		Benthic habitats exposed to oil or dispersants or oiled/injured may need to be restored via protection from other activities that could interfere with recovery.	Biologically important habitats harboring rare or sensitive species warranting protection from incompatible human activities.
O-20		Educating the public about injured natural resources can increase citizen sensitivity to those injuries and facilitate recovery as a result (e.g., avoidance of injured fishery species)	Citizens can help restore or conserve natural resources such as reducing their contribution of non-point source pollutants, following best boating and fishing practices, and minimizing impacts on sea turtle or bird nesting habitat,
O-18		Dispersed oil in water column and associated increases in microbial activity may have caused decreases in oxygen for marine species, especially bottom dwelling organisms (e.g., shrimp); compensatory restoration could offset decreased oxygen and habitat availability or quality for these species.	Northern Gulf dead zone off Louisiana and Texas; dozens of pockets of hypoxia throughout the Gulf
O-17	Protections could come in the form of fishery management	The oil spill covered known distributions, spawning	Western North Atlantic bluefin population critically

Ocean Habitats			
Option Code	**Notes**	**Nexus to Injury[19]**	**Relevance to Historical Issues and Broader Restoration**
	improvements and incorporating new research on life history characterization, trophic effects, and deepwater habitat utilization by multiple species into protection strategies.	habitat or larval areas for bluefin tuna, blue marlin and whale sharks. Many pelagics utilize *Sargassum* in early life history stages and *Sargassum* was exposed to oil and dispersants.	endangered due to overfishing; caught as bycatch in longline fisheries
O-06		Nearshore and offshore soft bottom habitats exposed to oil and dispersants in the oil spill impact zone	Some types of fishing practices (e.g., trawling, anchoring), energy development and associated infrastructure
O-04		Deepwater corals injured near wellhead and mesophotic corals likely exposed	Fishing and energy development
O-14		Soft bottom and hard bottom environments were exposed to oil and dispersants; lower impact fishing gear could reduce disturbance, aid recovery.	Historical trawling on soft or hard bottom environments
O-09	*Sargassum* harvest may not be a threat in the Gulf, but major gaps in knowledge of *Sargassum* species and communities exist. Invest in research on *Sargassum* dynamics, movement and faunal communities over time and space to better understand this habitat type and develop appropriate management strategies.	*Sargassum* exposed to oil and dispersants; oiled *Sargassum* burned or removed	*Sargassum* harvest is restricted in the South Atlantic; catch limits have been set.
O-13		Facilitating recovery of oiled or injured ocean habitats such as sea grasses, shallow water corals, *Sargassum*, live hard bottom environments and soft bottom habitats by removing marine debris that interferes with habitat function	Marine debris is a chronic issue in the Gulf.

Fishery Resources			
Option code	**Notes**	**Nexus to Injury Based on research findings or relevance of the option to DWH oil spill impact and recovery**	**Historical, Broader Issues/Impacts to be Addressed**
F-01		Reef fish species, highly migratory pelagic species, sharks, and invertebrates (e.g., shrimp) are among the marine fishery species exposed to oil or dispersants whose abundance and distribution warrant monitoring as part of tracking impacts and recovery.	Unassessed and possibly unmanaged fishery species may be due in part to insufficient biological information and gaps in surveys
F-27	Research should include fish that are currently showing signs of stress and lead to the identification of a full range of sublethal biomarkers.	Fish and invertebrate species exposed to oil and dispersants in the oil spill impact zone	Background levels of hydrocarbons and other pollutants in sediment or water column resulting in sublethal effects.
F-16	The types of information needed for an IEA need to include trophic dynamics and food web based on diet studies for commercial and prey fish species.	Many different taxa and habitats were impacted by the oil spill and a better understanding of the impacts on the food web and trophic interactions is needed or developing appropriate restoration strategies.	Scientists increasingly recognize the need to develop management strategies based on approaches that take ecosystem function and health into account.
F-14	More frequent stock assessments are needed to meet the demands of public. A related need is adding a sufficient amount of continuous training to research programs. Stock assessments currently do a poor job of incorporating oil spill impacts.	Fishery species such as menhaden, red snapper and other federally or state managed finfish or invertebrates (e.g., shrimp, blue crab) exposed to oil and dispersants could benefit from time-sensitive assessments needed to detect changes in populations; these assessments would in turn inform adaptive management to assist recovery.	Managers require frequent stock assessments and assessment updates to ensure that catch limits are established at appropriate levels. Lack of adequate and timely stock assessments remains a challenge for fisheries managers who are required to keep catches within specified limits and prevent overfishing.

Fishery Resources			
Option code	**Notes**	**Nexus to Injury Based on research findings or relevance of the option to DWH oil spill impact and recovery**	**Historical, Broader Issues/Impacts to be Addressed**
F-05	Red snapper is a species of interest for this program. Smart tags and electronic tags are useful for determining natural mortality rates.	Red snapper and other popular and heavily fished finfish species were exposed to oil and dispersants so tracking population trends is important to setting appropriate catch limits	Gulf Council has identified fish tagging as a priority in its 5-year research plan to better account for natural mortality in stock assessments
F-19	There is a need for better surveys that can be turned around quickly, both for fisheries management and oil spill response. The aim should be to increase catch and effort data in addition to what MRIP is mandated to capture. There is also a need to keep the private angling and for-hire sectors separate, because there are different and unique issues associated with monitoring each sector.	Popular reef fish (e.g., red snapper) caught by recreational anglers and exposed to oil and dispersants are showing signs of stress possibly related to DWH. Better, timelier fishery dependent data will help prevent overfishing and could help populations recover faster.	Lags in catch and effort data collected in the field and then used to estimate total catch for quota monitoring are inadequate for species with short fishing seasons
F-13		Federally managed species exposed to oil or dispersants that have not had their populations assessed	Populations of a large number of managed reef fish species in the Gulf have not been assessed
F-15		Fish and invertebrates managed by Gulf states and/or the Council were exposed to oil and dispersants over a wide area.	Stock assessments and recreational/commercial fishermen would benefit from improved data through improved estimates of population health and lower potential for exceeding quotas (overfishing).
F-10		Finfish species exposed to oil and dispersants are also caught incidentally in various Gulf fisheries. More observer coverage should improve bycatch estimates that scientists can use to assess population status and implications for recovery.	National report recommends additional days at sea for Gulf fishery observer programs.

Fishery Resources			
Option code	**Notes**	**Nexus to Injury Based on research findings or relevance of the option to DWH oil spill impact and recovery**	**Historical, Broader Issues/Impacts to be Addressed**
F-24		Menhaden's spring and summer distribution overlapped with the oil spill impact zone.	Menhaden are an important forage fish in the food web. Research recommendations from an October 2011 Gulf menhaden stock assessment identified the following research gaps: reproductive biology, predator/prey relations, genetics, and natural mortality through tagging studies. These studies are important components of an ecosystem assessment.
F-23		Some areas of the northern Gulf have higher incidence of diseased reef fish than others; possible link to DWH; fishermen can avoid areas with higher prevalence of diseased fish	Gulf Council's VMS Advisory Panel recommended improvements to the VMS program to be more user-friendly and relevant to fisheries management.
F-03		Pelagic species such as bluefin tuna and reef fish species such as red snapper were exposed to oil and dispersants; reductions in bycatch through better gear could reduce bycatch rates or mortality	Developing more selective gear is in development or experimental phase for pelagic longline fishery (e.g., greenstick)
F-22		Federally and state managed brown and white shrimp and reef fish (red snapper) caught as bycatch in the shrimp fishery were exposed to oil and dispersants.	Including a larger number of vessels in the ELB program would improve the precision of fishing effort and bycatch estimates for red snapper and help prevent overfishing
F-06	Any increase in catch resulting from no size limit might be achieved through closures of more spawning areas, avoidance of deeper areas, or other measures.	Reef fish species exposed to oil or dispersants are also caught as non-target species (regulatory discards), increasing fishing mortality deducted from quota	Gulf Council is exploring methods of reducing regulatory discards while maximizing fishing opportunity

Fishery Resources			
Option code	**Notes**	**Nexus to Injury Based on research findings or relevance of the option to DWH oil spill impact and recovery**	**Historical, Broader Issues/Impacts to be Addressed**
F-04		Fishery species such as red snapper exposed to oil and dispersants that concentrate around platforms.	DOI issues new policies resulting in a higher removal rate of obsolete platforms, potentially involving the use of explosives
F-21		Reef fish such as red snapper and groupers exposed to oil or dispersants	NMFS and NFWF piloting video cameras in reef fish fishery for potential wider application as a monitoring and management tool
F-11		Reef fish species such as red snapper were exposed to oil and dispersants.	Strong support exists within commercial fishing community for leasing red snapper quota to government on a temporary basis.
F-12		Fishery species (e.g., red snapper) and sea turtles caught as bycatch in the shrimp fishery were exposed to oil and dispersants	Federally managed shrimp fishery must keep red snapper bycatch mortality below a certain level to attain red snapper rebuilding goals.
F-07		Bluefin tuna eggs, larvae and adults exposed to oil and dispersants	Western North Atlantic bluefin population critically endangered due to overfishing; caught as bycatch in longline fisheries
F-25		Reef and pelagic fish species exposed to oil and dispersants	Hatcheries could provide an opportunity to study survival of different fish species through tagging or other methods

Marine Wildlife			
Option code	**Notes**	**Nexus to Injury**	**Historical, Broader Issues/Impacts to be Addressed**
M-20		Marine birds like northern gannets, marine mammals (e.g., bottlenose dolphin, sperm whale),and sea turtles (e.g., Kemp's ridley, loggerhead) were directly or indirectly exposed to oil or dispersants or affected by other response measures (e.g., nest translocation)	Likely expansion of oil, gas, wind energy development, commercial fishing (bycatch), shipping and climate change will put wildlife species at continued risk.
M-23		Sea turtles, seabirds, and marine mammals were impacted by the oil spill.	Obtaining biological information on abundance, movement patterns, and vital rates for these taxa would improve population assessments and better inform management or mitigation strategies.
M-19		Wildlife species, including bottlenose dolphin and sea turtles, were impacted and their recovery could be aided by reducing fisheries interactions and bycatch.	Commercial and recreational fisheries interact with sea turtles (bycatch) and dolphins (depredation).
M-01		Hundreds of sea turtle nesting beaches and nest were directly exposed to oil.	All sea turtles species native to the Gulf are listed as threatened or endangered under the Endangered Species Act. Nest protection is a strategy listed in ESA recovery plans for rebuilding populations.
M-21		Seabirds, marine mammals, and sea turtles were impacted by the oil spill.	Obtaining baseline information on abundance, and distribution for these taxa would improve population assessments to better predict and track impacts of future spills

Marine Wildlife			
Option code	**Notes**	**Nexus to Injury**	**Historical, Broader Issues/Impacts to be Addressed**
M-07		Several hundred marine mammals, sea birds and sea turtles stranded after the spill, and the first responders were in many cases the stranding network members. The relocation of sea turtle nests from beaches as a pre-response effort may have had unintended consequences for species involved.	Improving stranding network capacity is a priority of state and federal agencies and provides near real time information on animal mortalities for assessing severity of an event and shifting resources to hot spots.
M-14		Sea turtles and marine mammals impacted by the oil spill are caught as bycatch in Gulf fisheries.	Monitoring bycatch levels of wildlife species guides management efforts to reduce fisheries interactions
M-08		At least one population of bottlenose dolphin (in Barataria Bay, LA) was found to have health issues thought to be caused by the oil spill. Other populations have yet to be examined.	
M-22		Marine mammals affected by the spill, such as bottlenose dolphins and sperm whales.	Sources of ambient noise from seismic surveys associated with oil and gas resource detection have been shown to interfere with marine mammal behavior and could represent a chronic, sublethal impact
M-03		Sea turtle strandings spiked during and after the oil spill, with drowning identified as the cause of death in most cases, possibly resulting from higher interactions with shrimp trawl fisheries and changes in fishing behavior related to the spill. Observer coverage is inadequate and ELBs would help provide information on sea turtle and other bycatch.	Sea turtles ELB data are used by officials to identify hot spots where shrimp vessel and sea turtle interactions are highest. This knowledge can be used to address TED non-compliance issues or implement other mitigation strategies.

Marine Wildlife			
Option code	**Notes**	**Nexus to Injury**	**Historical, Broader Issues/Impacts to be Addressed**
M-04	Noncompliance remains problematic.	Sea turtles impacted by the oil spill are also taken in shrimp trawl fisheries, and TEDs are an effective means of reducing sea turtle bycatch in that gear.	Federally permitted vessels are required to use TEDs in federal waters but inshore, state-managed vessels using skimmer nets are not.
M-26		Marine mammals and sea turtles impacted by the oil spill could benefit from new technologies designed to monitor their movements and identify critical ecological relationships.	
M-25		The populations of hundreds of marine species impacted by the spill needs to be assessed to determine rate of recovery from the oil spill, yet there is a shortage of data analysts and modelers.	The need/demand for marine species assessments is in greater than the availability of population status scientists.
M-24		Sea turtles impacted by the oil spill are taken in commercial fisheries, and funds for a buy-out of specific fisheries could reduce bycatch mortality.	Sea turtle bycatch continues to be an issue in some Gulf fisheries; thousands of interactions as of 2009 with hundreds of dead sea turtles estimated.
M-11		Seabirds, marine mammals, and sea turtles impacted by the spill are known to entangle in and digest marine debris.	Marine debris is a chronic problem affecting wildlife through entanglement, ingestion or smothering. Most originates onshore, some offshore.
M-16	Making voluntary or offering incentives to vessel operators or owners might increase the success of implementation.	Sea turtles and other wildlife species impacted by the spill also interact with commercial fishing vessels.	Electronic video monitoring is a reliable, unbiased method of documenting wildlife interactions that can be used to estimate mortality against allowable take.
M-10		Birds and bird nesting beaches were impacted by the oil spill.	Restoration strategies for seabirds include protections for nesting habitat

Marine Wildlife			
Option code	**Notes**	**Nexus to Injury**	**Historical, Broader Issues/Impacts to be Addressed**
M-15		Seabirds were impacted by the oil spill. This technique has been used on platforms in the North Sea with some success.	MMS studied the issue of platforms and bird collisions and determined nocturnal circulation is one cause of collisions and related mortalities.
M-13		Birds were impacted by the oil spill. This technique has been used on the West Coast to help bird populations recover from oil spills.	

Human Uses			
Option code	**Notes**	**Nexus to Injury**	**Historical, Broader Issues/Impacts to be Addressed**
H-06		Recreational and commercial fisheries were impacted by the oil spill.	Improved valuation of recreational and commercial fisheries will better inform levels of compensation or disaster assistance for lost use.
H-12	A potential model for undertaking such work is described in Picou, J.S., Gill, D.A., Dyer, C.L. and Curry, E., 1992. Disruption and stress in an Alaskan fishing community: initial and continuing impacts of the Exxon Valdez oil spill. Industrial Crisis Quarterly, 6: 235-257.	Fishermen were affected by the oil spill through fishery closures and lost access to the resource, negative perceptions of contaminated seafood or potential direct or indirect exposure to oil or dispersants	Fishermen are disproportionately affected by natural or human disasters that impact the marine environment.
H-07		Non-consumptive uses of ecosystem services that attract visitors who support local economies were impacted by the oil spill.	

Human Uses			
Option code	**Notes**	**Nexus to Injury**	**Historical, Broader Issues/Impacts to be Addressed**
H-10		Subsistence users (e.g., Houma Indian Tribe) were affected by the oil spill.	
H-09	Public demand for an archive of information on Gulf of Mexico information and quick access to it is high, and access to such data is especially important for disaster response. All projects should have integrated information. The Harte Research Institute data repository may be available to help.	Many natural resources and related human uses were impacted by the oil spill. A catalog of injured natural resources and lost services/uses would assist researchers, officials and the public understand the ecological and economic magnitude of oil spill.	Mapping the Gulf's biological diversity and supporting human uses would help the public understand the importance of the ecosystem and could result in positive behavior or management changes favoring conservation and restoration.
H-04		Some citizens along the Gulf Coast refrained from consuming Gulf-caught seafood due to concerns about contamination; too little outreach to the public on seafood testing exacerbated negative perceptions.	Larger efforts are underway to help improve market confidence of Gulf seafood.
H-15		Trustees must seek the public's input on restoration actions, but to ensure this input is meaningful and relevant, summary information on injuries is important	There is precedent for giving the public a role in oil spill restoration planning (e.g., *Exxon Valdez*)
H-14	Enhance and expand cooperative research programs with recreational and commercial fishermen.	Recreational and commercial fishermen were impacted by the spill and have vessels that can be used to undertake fisheries research related to the oil spill	Existing cooperative research programs could house expanded research addressing oil spill impacts on fisheries similar to what LSU and USF/FIO are undertaking to study sick fish.
H-03	This issue is topical, but potentially controversial; some approaches (flexible use of fish tags, sector split, catch share co-ops, days at sea, management delegation to states) are under consideration. Industry is key to the outcome of deliberations on new approaches.	Recreational anglers were impacted by oil spill fishery closures and investments in new management approaches could help offset this lost access.	Some states (LA) and the Gulf Council are exploring or testing alternative recreational fisheries management approaches such as tournaments held outside of regular seasons.

Human Uses			
Option code	**Notes**	**Nexus to Injury**	**Historical, Broader Issues/Impacts to be Addressed**
H-05		Recreational anglers could not access normal fishing grounds due to oil spill closures; platforms are known provide fishing opportunity so maintaining them as such may compensate the angling public for lost access.	Platforms are receiving much attention in the recreational angling community as concerns about rapid rig removal grow. The value of rigs as sanctuaries for other species needs to be assessed and better understood for conservation purposes.
H-08		Recreational opportunities enjoyed by tourists and local citizens were impacted by the oil spill. Public education is a form of restoration that has been carried out following other spills.	Broader initiatives such as "leave no child inside" encourage outdoor recreation.
H-11		The public's access to natural resources in the marine environment was temporarily restricted.	
H-01		Subsistence and commercial fishermen lost access to fishing grounds during the spill.	Fuel-efficient gear that results in cost savings and higher product quality is available in the shrimp fishery; adoption of gear requires training.
H-02		For-hire or commercial permit holders impacted by the spill.	Buybacks could benefit fisheries by removing latent effort that could be re-activated when economic conditions improve, potentially increasing fishing pressure and bycatch and exacerbating overfishing concerns.