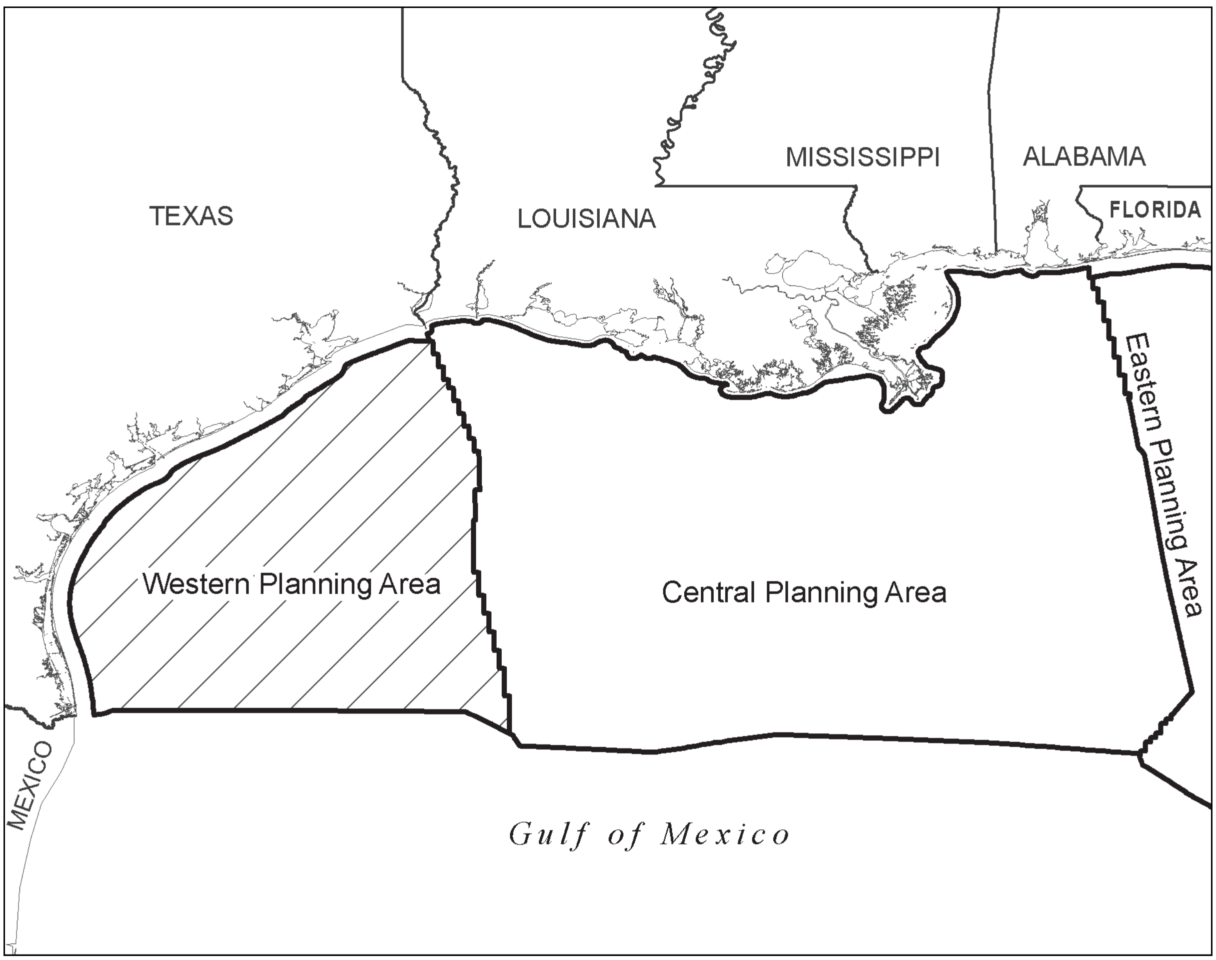
OCS EIS/EA
BOEMRE 2011-034

Gulf of Mexico OCS
Oil and Gas Lease Sale: 2011

Western Planning Area Lease Sale 218

Final Supplemental Environmental Impact Statement

Volume I: Chapters 1-4



U.S. Department of the Interior
**Bureau of Ocean Energy Management,
Regulation and Enforcement**
Gulf of Mexico OCS Region

OCS EIS/EA
BOEMRE 2011-034

Gulf of Mexico OCS
Oil and Gas Lease Sale: 2011

Western Planning Area Lease Sale 218

Final Supplemental Environmental Impact Statement

Volume I: Chapters 1-4

Author

Bureau of Ocean Energy Management,
Regulation and Enforcement
Gulf of Mexico OCS Region

Published by

U.S. Department of the Interior
Bureau of Ocean Energy Management,
Regulation and Enforcement
Gulf of Mexico OCS Region

New Orleans
August 2011

REGIONAL DIRECTOR'S NOTE

In the *Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012,* six annual areawide lease sales are scheduled for the Central Planning Area (CPA) and five annual areawide lease sales are scheduled for the Western Planning Area (WPA). Federal regulations allow for several related or similar proposals to be analyzed in one environmental impact statement (EIS) (40 CFR 1502.4). Since each lease sale proposal and projected activities are very similar each year for each sale area, this Agency prepared a single EIS for the 11 lease sales: *Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222, Final Environmental Impact Statement.* The Gulf of Mexico Energy Security Act of 2006 (P.L. 109-432, December 20, 2006) repealed the Congressional moratorium on certain areas of the Gulf of Mexico, placed a moratorium on other areas in the Gulf of Mexico, and increased the distribution of offshore oil and gas revenues to coastal States. The remaining eight CPA and WPA sales were analyzed in the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218, Final Supplemental Environmental Impact Statement.*

This Final Supplemental EIS was prepared because of the potential changes to the baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the *Deepwater Horizon* (DWH) event between April 20 and July 15, 2010 (the period when oil flowed from the Macondo well in Mississippi Canyon Block 252); (2) the acute impacts that have been reported or surveyed since that time; and (3) any new information that may be available. The environmental resources include sensitive coastal environments, offshore benthic resources, marine mammals, sea turtles, coastal and marine birds, endangered and threatened species, and fisheries. This Final Supplemental EIS analyzes the potential impacts of the proposed action on the marine, coastal, and human environments. It is important to note that this Final Supplemental EIS was prepared using the best information that was publicly available at the time the document was prepared.

At the completion of this Supplemental EIS process, a decision will be made only for proposed Lease Sale 218 in the Western Planning Area.

The Gulf of Mexico OCS Region of the Bureau of Ocean Energy Management, Regulation and Enforcement has been conducting environmental analyses of the effects of Outer Continental Shelf (OCS) oil and gas development since the inception of the National Environmental Policy Act of 1969. We have prepared and published more than 50 draft and final EIS's. Our goal has always been to provide factual, reliable, and clear analytical statements in order to inform decisionmakers and the public about the environmental effects of proposed OCS activities and their alternatives. We view the EIS process as providing a balanced forum for early identification, avoidance, and resolution of potential conflicts. It is in this spirit that we welcome comments on this document from all concerned parties.

Lars Herbst

Lars Herbst
Regional Director
Bureau of Ocean Energy Management,
Regulation and Enforcement
Gulf of Mexico OCS Region

COVER SHEET

Supplemental Environmental Impact Statement
for
Proposed Western Planning Area OCS Oil and Gas Lease Sale 218

	Draft ( )	**Final (x)**
Type of Action:	Administrative (x)	Legislative ( )

Area of Potential Impact: Offshore Marine Environment and Coastal Counties/Parishes of Texas and Louisiana

Agency	Washington Contact	Region Contacts
U.S. Department of the Interior Bureau of Ocean Energy Management, Regulation and Enforcement Gulf of Mexico OCS Region MS 5410 1201 Elmwood Park Boulevard New Orleans, LA 70123-2394	Keely Hite (MS 4042) U.S. Department of the Interior Bureau of Ocean Energy Management, Regulation and Enforcement 381 Elden Street Herndon, VA 20170-4817 (703) 787-1662	Barry Obiol (504) 736-2786 Gary Goeke (504) 736-3233

ABSTRACT

This Final Supplemental Environmental Impact Statement (EIS) covers proposed Gulf of Mexico OCS oil and gas Lease Sale 218 in the Western Planning Area.

This Supplemental EIS tiers from the following EIS's: the *Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012, Final Environmental Impact Statement* (5-Year Program EIS; USDOI, MMS, 2007a), which defined the national program; the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222, Final Environmental Impact Statement* (Multisale EIS; USDOI, MMS, 2007b), which defined the 5-Year Program in the GOM; and the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218, Final Supplemental Environmental Impact Statement* (2009-2012 Supplemental EIS; USDOI, MMS, 2008a), which was required after passage of the Gulf of Mexico Energy Security Act of 2006.

This Final Supplemental EIS was prepared because of the potential changes to baseline conditions that took place in 2010 as a result of (1) the *Deepwater Horizon* event between April 20 and July 15, 2010 (the period when oil flowed from the Macondo well in Mississippi Canyon Block 252); (2) the potentially acute impacts that have been reported or surveyed since that time; and (3) any new information that may be available. The environmental resources include sensitive coastal environments, offshore benthic resources, marine mammals, sea turtles, coastal and marine birds, endangered and threatened species, and fisheries. This Final Supplemental EIS analyzes the potential impacts of the proposed action on the marine, coastal, and human environments. It is important to note that this Final Supplemental EIS was prepared using the best information that was publicly available at the time the document was prepared. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives, and if so, was either acquired or in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place.

The proposed action is a major Federal action requiring an EIS. This document provides the following information in accordance with the National Environmental Policy Act and its implementing regulations, and it will be used in making decisions on the proposal. This document includes the purpose

and background of the proposed action, identification of the alternatives, description of the affected environment, and an analysis of the potential environmental impacts of the proposed action, alternatives, and associated activities, including proposed mitigating measures and their potential effects. Potential contributions to cumulative impacts resulting from activities associated with the proposed action are also analyzed.

Hypothetical scenarios were developed on the levels of activities, accidental events (such as oil spills), and potential impacts that might result if the proposed action is adopted. Activities and disturbances associated with the proposed action on biological, physical, and socioeconomic resources are considered in the analyses.

Additional copies of this Supplemental EIS, the Multisale EIS, the 2009-2012 Supplemental EIS, and the other referenced publications may be obtained from the BOEMRE, Gulf of Mexico OCS Region, Public Information Office (MS 5034), 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394, or by telephone at 504-736-2519 or 1-800-200-GULF.

SUMMARY

Under the *Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012* (5-Year Program; USDOI, MMS, 2007c), six annual areawide lease sales were scheduled for the Central Planning Area (CPA) and five annual areawide lease sales were scheduled for the Western Planning Area (WPA) of the Gulf of Mexico (GOM) Outer Continental Shelf (OCS). Those 11 CPA and WPA sales were analyzed in the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222, Final Environmental Impact Statement* (Multisale EIS; USDOI, MMS, 2007b) and are hereby incorporated by reference.

The Gulf of Mexico Energy Security Act (GOMESA) of 2006 (P.L. 109-432, December 20, 2006) repealed the Congressional moratorium on certain areas of the Gulf of Mexico, placed a moratorium on other areas in the Gulf of Mexico, and increased the distribution of offshore oil and gas revenues to coastal States. The remaining seven CPA and WPA sales were analyzed in the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218, Final Supplemental Environmental Impact Statement* (2009-2012 Supplemental EIS; USDOI, MMS, 2008a) and are hereby incorporated by reference.

This Supplemental environmental impact statement (EIS) supplements the Multisale EIS and the 2009-2012 Supplemental EIS. This Supplemental EIS analyzes the potential environmental effects of oil and natural gas leasing, exploration, development, the effects of the *Deepwater Horizon* (DWH) event, and all new information available for the WPA since the publication of the Multisale EIS and the 2009-2012 Supplemental EIS. The purpose of this Supplemental EIS is to determine if there are significant new circumstances or information available relating to the proposed action or its impacts and to disclose any changes, if any, in conclusions stated in the Multisale EIS and the 2009-2012 Supplemental EIS. This includes all significant new information and not just that acquired in response to the DWH event. It must be understood that this Supplemental EIS analyzes the proposed action and alternatives for a sale in the WPA. This is not an EIS on the DWH event itself, although information on this event will be analyzed as it applies to resources in the WPA. Proposed WPA Lease Sale 218 is the Federal action addressed in this Supplemental EIS and is the remaining areawide oil and gas lease sale in the WPA.

In the National Environmental Policy Act (NEPA) implementing regulations (40 CFR 1508.28), "tiering" refers to the coverage of general matters in a broader EIS (such as national program), with subsequent narrower statements of environmental analyses (such as regional action). Tiering is appropriate in this instance as broader program issues have already been subjected to analysis, and this Supplemental EIS is more narrowly focused on the site-specific statement or analysis for proposed WPA Lease Sale 218. This Supplemental EIS tiers from the following EIS's: the *Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012, Final Environmental Impact Statement* (5-Year Program EIS; USDOI, MMS, 2007a), which defined the national program; the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222, Final Environmental Impact Statement* (Multisale EIS; USDOI, MMS, 2007b), which defined the 5-Year Program in the GOM; and the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218, Final Supplemental Environmental Impact Statement* (2009-2012 Supplemental EIS; USDOI, MMS, 2008a), which was required after the passage of GOMESA.

This summary section is only a brief overview of the proposed lease sale, alternatives, significant issues, potential environmental and socioeconomic effects, and proposed mitigating measures contained in this Supplemental EIS. To obtain the full perspective and context of the potential environmental and socioeconomic impacts discussed, it is necessary to read the entire analyses. Relevant discussions can be found in the chapters of this Supplemental EIS as described below.

- **Chapter 1**, The Proposed Action, describes the purpose of and need for the proposed lease sale and describes the prelease process.
- **Chapter 2**, Alternatives Including the Proposed Action, describes the environmental and socioeconomic effects of the proposed lease sale and alternatives. Also discussed are potential mitigating measures to avoid or minimize impacts.

- **Chapter 3**, Impact-Producing Factors and Scenario, describes activities associated with the proposed lease sale and the OCS Program, and other foreseeable activities that could potentially affect the biological, physical, and socioeconomic resources of the Gulf of Mexico.

  Chapter 3.1, Impact-Producing Factors and Scenario—Routine Events, describes offshore infrastructure and activities (impact-producing factors) associated with the proposed lease sale that could potentially affect the biological, physical, and socioeconomic resources of the Gulf of Mexico.

  Chapter 3.2, Impact-Producing Factors and Scenario—Accidental Events, discusses potential accidental events (i.e., oil spills, losses of well control, vessel collisions, and spills of chemicals or drilling fluids) that may occur as a result of activities associated with the proposed lease sale.

  Chapter 3.3, Cumulative Activities Scenario, describes past, present, and reasonably foreseeable future human activities, including non-OCS activities, as well as all OCS activities, that may affect the biological, physical, and socioeconomic resources of the Gulf of Mexico.

- **Chapter 4**, Description of the Environment and Impact Analysis, describes the affected environment and provides analysis of the routine, accidental, and cumulative impacts of the WPA proposed action and the alternatives on environmental and socioeconomic resources of the Gulf of Mexico.

  Chapter 4.1, Alternatives Including the Proposed Action, describes the impacts of the proposed action and two alternatives to the WPA proposed action on the biological, physical, and socioeconomic resources of the Gulf of Mexico.

  Chapter 4 also includes **Chapter 4.2**, Unavoidable Adverse Impacts of the Proposed Action; **Chapter 4.3**, Irreversible and Irretrievable Commitment of Resources; and **Chapter 4.4**, Relationship Between the Short-term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity.

- **Chapter 5**, Consultation and Coordination, describes the consultation and coordination activities with Federal, State, and local agencies and other interested parties that occurred during the development of this Supplemental EIS.
- **Chapter 6**, References Cited, is a list of literature cited throughout this Supplemental EIS.
- **Chapter 7**, Preparers, is a list of names of persons who were primarily responsible for preparing and reviewing this Supplemental EIS.
- **Chapter 8,** Glossary, is a list of specialized words with brief definitions used in this document.

Proposed Action and Alternatives

The following alternatives were included for analysis in the Multisale EIS. No new alternatives were proposed for proposed WPA Lease Sale 218.

Alternatives for Proposed Western Planning Area Lease Sale 218

Alternative A—The Proposed Action: This alternative would offer for lease all unleased blocks within the WPA for oil and gas operations (**Figure 2-1**), except the following:

(1) whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary; and

(2) whole and partial blocks that lie within the former Western Gap portion of the 1.4-nautical-mile (nmi) buffer zone north of the continental shelf boundary between the U.S. and Mexico.

The WPA encompasses about 28.7 million acres (ac). Approximately 18.3 million ac (64%) of the WPA sale area is currently unleased. The estimated amount of natural resources projected to be developed as a result of the proposed WPA lease sale is 0.222-0.423 billion barrels of oil (BBO) and 1.495-2.647 trillion cubic feet (Tcf) of gas.

Alternative B—The Proposed Action Excluding the Unleased Blocks Near Biologically Sensitive Topographic Features: This alternative would offer for lease all unleased blocks in the WPA sale area, as described for the proposed action, with the exception of any unleased blocks subject to the Topographic Features Stipulation.

Alternative C—No Action: This alternative is the cancellation of the proposed WPA lease sale. The opportunity for development of the estimated 0.222-0.423 BBO and 1.495-2.647 Tcf of gas that could have resulted from the proposed WPA lease sale would be precluded or postponed. Any potential environmental impacts resulting from the proposed lease sale would not occur or would be postponed. This is analyzed in the Final EIS for the 5-Year Program on a nationwide programmatic level.

Mitigating Measures

Proposed lease stipulations and other mitigating measures designed to reduce or eliminate environmental risks and/or potential multiple-use conflicts between OCS operations and U.S. Department of Defense activities may be applied to the chosen alternative. Four lease stipulations are proposed for the proposed WPA lease sale—the Topographic Features Stipulation, the Military Areas Stipulation, the Protected Species Stipulation, and the Law of the Sea Convention Royalty Payment Stipulation. The Law of the Sea Convention Royalty Payment Stipulation is applicable to WPA Lease Sale 218 even though it is not an environmental or military stipulation. The Naval Mine Warfare Area Stipulation is no longer applicable to the WPA lease sale area by memorandum dated April 3, 2009, from the Department of the Navy.

Application of lease stipulations will be considered by the Assistant Secretary of the Interior for Land and Minerals (ASLM). The inclusion of the stipulations as part of the analysis of the proposed action does not ensure that the ASLM will make a decision to apply the stipulations to leases that may result from the proposed lease sale, nor does it preclude minor modifications in wording during subsequent steps in the prelease process if comments indicate changes are necessary or if conditions warrant. Any stipulations or mitigation requirements to be included in the lease sale will be described in the Final Notice of Sale. Mitigation measures in the form of lease stipulations are added to the lease terms and are therefore enforceable as part of the lease.

Scenarios Analyzed

Offshore activities are described in the context of scenarios for the proposed action (**Chapter 3.1**) and for the OCS Program (**Chapter 3.3**). The Bureau of Ocean Energy Management, Regulation and Enforcement's (BOEMRE's) Gulf of Mexico OCS Region developed these scenarios to provide a framework for detailed analyses of potential impacts of the proposed lease sale. The scenarios are presented as ranges of the amounts of undiscovered, unleased hydrocarbon resources estimated to be leased and discovered as a result of the proposed action. The analyses are based on a traditionally employed range of activities (e.g., the installation of platforms, wells, and pipelines, and the number of helicopter operations and service-vessel trips) that would be needed to develop and produce the amount of resources estimated to be leased.

The cumulative analysis (**Chapter 4.1**) considers environmental and socioeconomic impacts that may result from the incremental impact of the proposed action when added to all past, present, and reasonably foreseeable future activities, including non-OCS activities such as import tankering and commercial fishing, as well as all OCS activities (OCS Program). The OCS Program scenario includes all activities that are projected to occur from past, proposed, and future lease sales during the 40-year analysis period. This includes projected activity from lease sales that have been held, but for which exploration or development has not yet begun or is continuing. In addition to human activities, impacts from natural occurrences, such as hurricanes, are analyzed.

Significant Issues

The major issues that frame the environmental analyses in this Supplemental EIS are the result of concerns raised during years of scoping for the Gulf of Mexico OCS Program. Issues related to OCS exploration, development, production, and transportation activities include the potential for oil spills, wetlands loss, air emissions, discharges, water quality degradation, trash and debris, structure and pipeline emplacement activities, platform removal, vessel and helicopter traffic, multiple-use conflicts, support services, population fluctuations, demands on public services, land-use planning, impacts to tourism, aesthetic interference, cultural impacts, environmental justice, and conflicts with State coastal zone management programs. Environmental resources and activities identified during the scoping process to warrant an environmental analysis include air quality, water quality, coastal barrier beaches and associated dunes, wetlands, seagrass communities, topographic features, *Sargassum*, deepwater benthic communities, marine mammals, sea turtles, coastal and marine birds, fish resources and essential fish habitat, commercial and recreational fishing, recreational resources, archaeological resources, socioeconomic conditions, soft bottoms, and diamondback terrapins.

Other relevant issues include impacts from the DWH event and from past and future hurricanes on environmental and socioeconomic resources, and on coastal and offshore infrastructure. During the past few years, the Gulf Coast States and Gulf of Mexico oil and gas activities have been impacted by major hurricanes. Appendix A.3 of the Multisale EIS provides detailed information on Hurricanes Lili (2002), Ivan (2004), Katrina (2005), and Rita (2005), which are discussed in **Chapter 4**. The description of the affected environment (**Chapter 4.1**) includes impacts from these storms, as well as Hurricanes Gustav (2008) and Ike (2008), on the physical environment, biological environment, and socioeconomic activities and OCS-related infrastructure. Baseline data are considered in the assessment of impacts from the proposed action to the resources and the environment (**Chapter 4.1)**.

Impact Conclusions

The BOEMRE has reexamined the analysis presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on additional significant information available since the publication of the Multisale EIS and the 2009-2012 Supplemental, and new circumstance and information relating to the DWH event. None of the additional information analyzed in this Supplemental EIS was found to alter the environmental concerns and impact conclusions as presented in the Multisale EIS and the 2009-2012 Supplemental EIS for a WPA lease sale. In some cases, the additional information supported the conclusions in the Multisale EIS and the 2009-2012 Supplemental EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the proposed action and the proposed action's incremental contribution to the cumulative impacts are described in **Chapter 4.1**. A summary of the potential impacts from the WPA proposed action on each environmental and socioeconomic resource and the conclusions of the analyses can be found below.

Air Quality: Emissions of pollutants into the atmosphere from the routine activities associated with the WPA proposed action are projected to have minimal impacts to onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline, and are expected to be well within the National Ambient Air Quality Standards (NAAQS). While regulations are in place to reduce the risk of impacts from H_2S and while no H_2S-related deaths have occurred on the OCS, accidents involving high concentrations of hydrogen sulfide (H_2S) could result in deaths as well as environmental damage. These emissions from routine activities and accidental events associated with the proposed action are not expected to have concentrations that would change onshore air quality classifications.

Coastal and Offshore Waters: Impacts from routine activities associated with the WPA proposed action would be minimal. Coastal water impacts associated with routine activities include increases in turbidity resulting from pipeline installation and navigation canal maintenance, discharges of bilge and ballast water from support vessels, and run-off from shore-based facilities. Offshore water impacts associated with routine activities result from the discharge of drilling muds and cuttings, produced water, residual chemicals used during workovers, structure installation and removal and pipeline placement. The discharge of drilling muds and cuttings cause temporary increased turbidity and changes in sediment composition. The discharge of produced water results in increased concentrations of some metals, hydrocarbons, and dissolved solids within an area of about 100 meters (m) (328 feet [ft]) adjacent to the point of discharge. Structure installation and removal and pipeline placement disturbs the sediments and causes increased turbidity. In addition, offshore water impacts result from supply and service-vessel bilge and ballast water discharges.

Small spills (<1,000 barrels [bbl]) are not expected to significantly impact water quality in coastal or offshore waters. Large spills (≥1,000 bbl), however, could impact water quality in coastal waters. Accidental chemical spills, release of synthetic-based fluid (SBF), and blowouts would have temporary localized impacts on water quality.

Coastal Barrier Beaches and Associated Dunes: Routine activities in the WPA such as increased vessel traffic, maintenance dredging of navigation canals, and pipeline installation would cause negligible impacts and would not deleteriously affect barrier beaches and associated dunes. Indirect impacts from routine activities are negligible and indistinguishable from direct impacts of onshore activities. The potential impacts from accidental events, primarily oil spills, associated with the WPA proposed action are anticipated to be minimal.

Wetlands: Routine activities in the WPA such as pipeline emplacement, navigational channel use, maintenance dredging, disposal of OCS wastes, and construction and maintenance of OCS support infrastructure in coastal areas are expected to result in low impacts. Indirect impacts from wake erosion and saltwater intrusion are expected to result in low impacts that are indistinguishable from direct impacts from inshore activities. The potential impacts from accidental events, primarily oil spills, are anticipated to be minimal.

Seagrass Communities: Turbidity impacts from pipeline installation and maintenance dredging associated with the proposed action would be temporary and localized. The increment of impacts from service-vessel transit associated with the proposed action would be minimal. Should an oil spill occur near a seagrass community, impacts from the spill and cleanup would be considered short term in duration and minor in scope. Close monitoring and restrictions on the use of bottom-disturbing equipment to clean up the spill would be needed to avoid or minimize those impacts.

Topographic Features: The routine activities associated with the WPA proposed action that would impact topographic feature communities include anchoring, infrastructure and pipeline emplacement, infrastructure removal, drilling discharges, and produced-water discharges. However, adherence to the proposed Topographic Features Stipulation would make damage to the ecosystem unlikely. Contact with accidentally spilled oil would cause lethal and sublethal effects in benthic organisms, but the oiling of benthic organisms is not likely because of the small area of the banks, the scattered occurrence of spills, the depth of the features, and because the proposed Topographic Features Stipulation, if applied, would keep subsurface sources of spills away from the immediate vicinity of topographic features.

Sargassum: The impacts to *Sargassum* that are associated with the proposed action are expected to have only minor effects to a small portion of the *Sargassum* community as a whole. The *Sargassum* community lives in pelagic waters with generally high water quality and would be resilient to the minor effects predicted. It has a yearly cycle that promotes quick recovery from impacts. No measurable impacts are expected to the overall population of the *Sargassum* community from the WPA proposed action.

Chemosynthetic and Nonchemosynthetic Deepwater Benthic Communities: Chemosynthetic and nonchemosynthetic communities are susceptible to physical impacts from structure placement, anchoring, and pipeline installation associated with the WPA proposed action; however, the provisions of Notice to Lessees and Operators (NTL) 2009-G40 greatly reduce the risk of these physical impacts by clarifying that avoidance of potential chemosynthetic communities, and by consequence avoidance of other hard-bottom communities, is required. Even in situations where substantial burial of typical benthic infaunal communities occurred, recolonization from populations from widespread, neighboring, soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms. Potential accidental events associated with the proposed action are expected to cause little damage to the ecological function or biological productivity of the widespread, low-density chemosynthetic communities and the widespread, typical, deep-sea benthic communities.

Marine Mammals: Routine events related to the WPA proposed action, particularly when mitigated as required by BOEMRE, are not expected to have long-term adverse effects on the size and productivity of any marine mammal species or population endemic to the northern Gulf of Mexico. Characteristics of impacts from accidental events depend on chronic or acute exposure resulting in harassment, harm, or mortality to marine mammals, while exposure to dispersed hydrocarbons is likely to result in sublethal impacts.

Sea Turtles: The routine activities of the WPA proposed action are unlikely to have significant adverse effects on the size and recovery of any sea turtle species or population in the Gulf of Mexico. Accidental events associated with the proposed action have the potential to impact small to large numbers of sea turtles. Populations of sea turtles in the northern Gulf of Mexico would be exposed to residuals of oils spilled as a result of the proposed action during their lifetimes. While chronic or acute exposure from accidental events may result in the harassment, harm, or mortality to sea turtles, in most foreseeable cases, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick would result in sublethal impacts.

Coastal and Marine Birds: The majority of effects resulting from routine activities associated with the WPA proposed action on endangered/threatened and nonendangered/nonthreatened coastal and marine birds are expected to be sublethal. These effects include behavioral effects, exposure to or intake of OCS-related contaminants or discarded debris, temporary disturbances, and displacement of localized groups from impacted habitats. Impacts from potential oil spills associated with the proposed action and oil-spill cleanup on birds are expected to be negligible; however, small amounts of oil can affect birds, and there are possible delayed impacts on their food supply.

Fish Resources and Essential Fish Habitat: Fish resources and essential fish habitat could be impacted by coastal environmental degradation, marine environmental degradation, pipeline trenching, and offshore discharges of drilling discharges and produced waters associated with routine activities. The impact of coastal and marine environmental degradation is expected to cause an undetectable decrease in fish resources or in essential fish habitat. Impacts of routine discharges are localized in time and space and are regulated by U.S. Environmental Protection Agency permits and would have minimal impact. Accidental events that could impact fish resources and essential fish habitat include blowouts and oil or chemical spills. A subsurface blowout would have a negligible effect on Gulf of Mexico fish resources. If spills due to the proposed action were to occur in open waters of the OCS proximate to mobile adult finfish or shellfish, the effects would likely be nonfatal, and the extent of damage would be reduced due to the capability of adult fish and some adult shellfish to avoid a spill.

Commercial Fishing: Routine activities in the WPA, such as seismic surveys and pipeline trenching, would cause negligible impacts and would not deleteriously affect commercial fishing activities. Indirect impacts from routine activities to inshore habitats are negligible and indistinguishable from direct impacts of inshore activities on commercial fisheries. The potential impacts from accidental events, a well blowout or an oil spill, associated with the WPA proposed action are anticipated to be minimal. Commercial fishermen are anticipated to avoid the area of a well blowout or an oil spill. Any impact on catch or value of catch would be insignificant compared with natural variability.

Recreational Fishing: Routine activities in the WPA, such as seismic surveys and pipeline trenching, would cause negligible impacts and would not deleteriously affect recreational fishing activities. Indirect impacts to inshore habitats are negligible and indistinguishable from direct impacts of inshore activities on recreational fisheries. Temporary localized impacts to recreational fishermen from oil spills are anticipated as a result of the WPA proposed action and possibly some loss of revenue to facilities supported by recreational fishermen such as boat launches and bait shops.

Recreational Resources: While marine debris and nearshore operations, either individually or collectively, may adversely affect the quality of some recreational experiences, they are unlikely to reduce the number of recreational visits to Gulf Coast beaches. Except for a catastrophic spill such as the DWH event, it is unlikely that a spill would be a major threat to recreational beaches because any impacts would be short term and localized, and should have no long-term effect on tourism.

Historic and Prehistoric Archaeological Resources: The greatest potential impact to an archaeological resource as a result of routine activities associated with the WPA proposed action would result from direct contact between an offshore activity (e.g., platform installation, drilling rig emplacement, and dredging or pipeline project) and a historic or prehistoric site. The archaeological survey and archaeological clearance of sites, where required prior to an operator beginning oil and gas activities on a lease, are expected to be highly effective at identifying possible offshore archaeological sites; however, should such contact occur, there would be damage to or loss of significant and/or unique archaeological information. It is expected that coastal archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities.

It is not very likely that a large oil spill would occur and contact coastal prehistoric or historic archaeological sites from accidental events associated with the proposed action. Should a spill contact a prehistoric archaeological site, damage might include loss of radiocarbon-dating potential, direct impact from oil-spill cleanup equipment, and/or looting resulting in the irreversible loss of unique or significant archaeological information. The major effect from an oil-spill impact on coastal historic archaeological sites would be visual contamination, which would be temporary and reversible.

Land Use and Coastal Infrastructure: The WPA proposed action would not require additional coastal infrastructure, with the exception of possibly one new gas processing facility and one new pipeline landfall, and it would not alter the current land use of the analysis area. The existing oil and gas infrastructure is expected to be sufficient to handle development associated with the proposed action. There may be some expansion at current facilities, but the land in the analysis area is sufficient to handle such development. There is also sufficient land to construct a new gas processing plant in the analysis area, should it be needed. Accidental events such as oil or chemical spills, blowouts, and vessel collisions would have no effects on land use. Coastal or nearshore spills, as well as vessel collisions, could have short-term adverse effects on coastal infrastructure requiring cleanup of any oil or chemicals spilled.

Demographics: The WPA proposed action is projected to minimally affect the demography of the analysis area. Population impacts from the proposed action are projected to be minimal (<1% of total population) for any economic impact area in the Gulf of Mexico region. The baseline population patterns and distributions, as projected and described in Chapter 3.3.5.4 of the Multisale EIS, are expected to remain unchanged as a result of the proposed action. The increase in employment is expected to be met primarily with the existing population and available labor force with the exception of some in-migration (from elsewhere within or outside the U.S.), which is projected to move into focal areas such as Port Fourchon. Accidental events associated with the proposed action, such as oil or chemical spills, blowouts, and vessel collisions, would have likely no effects on the demographic characteristics of the Gulf coastal communities.

Economic Factors: The WPA proposed action is expected to generate less than a 1 percent increase in employment in any of the coastal subareas, even when the net employment impacts from accidental events are included. Most of the employment related to the proposed action is expected to occur in Texas and Louisiana. The demand would be met primarily with the existing population and labor force.

Environmental Justice: Environmental justice implications arise indirectly from onshore activities conducted in support of OCS exploration, development, and production. Because the onshore infrastructure support system for OCS-related industry (and its associated labor force) is highly developed, widespread, and has operated for decades within a heterogeneous Gulf of Mexico population, the proposed action is not expected to have disproportionately high or adverse environmental or health effects on minority or low-income people. The WPA proposed action would help to maintain ongoing levels of activity rather than expand them.

Soft-Bottom Habitats: The routine activities associated with the WPA proposed action that would impact soft bottoms generally occur within a few hundred meters of platforms, and the greatest impacts are seen close to the platform communities. Although localized impacts to comparatively small areas of the soft-bottom benthic habitats would occur, the impacts would be on a relatively small area of the seafloor compared with the overall area of the seafloor of the WPA (115,645 square kilometers [km^2]; 44,651 square miles [mi^2]). The WPA proposed action is not expected to adversely impact the entire soft-bottom environment because the local impacted areas are extremely small compared with the entire seafloor of the Gulf of Mexico.

Diamondback Terrapins: The routine activities of the WPA proposed action are unlikely to have significant adverse effects diamondback terrapins. Accidental events associated with the proposed action have the potential to impact small to large numbers of terrapins. Due to the extended distance from shore, impacts associated with activities occurring as a result of the WPA proposed action are not expected to impact terrapins or their habitat.

TABLE OF CONTENTS

Volume I

Page

Volume II

Page

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

°C	degree Celsius
°F	degree Fahrenheit
2009-2012 Supplemental EIS	*Gulf of Mexico OCS Oil and Gas Lease Sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218; Final Supplemental Environmental Impact Statement*
2D	two-dimensional
3D	three-dimensional
4D	four-dimensional
5-Year Program	*Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012*
5-Year Program EIS	*Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012, Final Environmental Impact Statement*
ac	acre
ACP	Area Contingency Plans
ANPR	Advance Notice of Proposed Rulemaking
APD	Application for Permit to Drill
APE	area of potential effect
API	American Petroleum Institute
ASLM	Assistant Secretary of the Interior for Land and Minerals
BAST	best available and safest technology
bbl	barrel
BBO	billion barrels of oil
B.C.	before Christ
Bcf	billion cubic feet
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	blowout preventer
B.P.	before present
BP	British Petroleum
BTEX	benzene, ethylbenzene, toluene, and xylene
CAA	Clean Air Act of 1970
CAAA	Clean Air Act Amendments of 1990
CD	Consistency Determination
CDP	common-depth-point (seismic surveying)
CEEDS	*Complete Economic and Demographic Data Source*
CEI	Coastal Environments, Inc.
CEQ	Council on Environmental Quality
CER	categorical exclusion review
CFR	Code of Federal Regulations
CG	Coast Guard (also: USCG)
CH_4	methane
CIAP	Coastal Impact Assistance Program
cm	centimeter
CMP	Coastal Management Plans
CO	carbon monoxide
CO_2	carbon dioxide
COE	Corps of Engineers (U.S. Army)
COF	covered offshore facilities
CPA	Central Planning Area
CPS	coastal political subdivisions
CRS	Congressional Research Service
CSA	Continental Shelf Associates
CWPPRA	Coastal Wetlands Protection, Planning & Restoration Act

CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	decibel
DOCD	development operations coordination document
DOD	Department of Defense (U.S.)
DOE	Department of Energy (U.S.) (also: USDOE)
DOI	Department of the Interior (U.S.) (also: USDOI)
DOT	Department of Transportation (U.S.) (also: USDOT)
DPP	development and production plan
DWH	*Deepwater Horizon*
DWOP	deepwater operations plan
EA	environmental assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
e.g.	for example
Eh	oxidation reduction potential
EIA	Economic Impact Area
EIA	Energy Information Administration (USDOE)
EIS	environmental impact statement
EP	exploration plan
EPA	Eastern Planning Area
EPAct	Energy Policy Act of 2005
ERCO	Energy Resources Co., Inc.
ESA	Endangered Species Act of 1973
ESI	Environmental Sensitivity Indexes
ESP	Environmental Studies Program
ESPIS	Environmental Studies Program Information System
et al.	and others
et seq.	and the following
EWTA	Eglin Water Test Area
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FPSO	floating production, storage, and offloading system
FR	*Federal Register*
ft	feet
FWS	Fish and Wildlife Service
FY	fiscal year
G&G	geological and geophysical
gal	gallon
GAO	Government Accountability Office (U.S.)
GCCF	Gulf Coast Claims Facility
GERG	Geochemical and Environmental Research Group
GIWW	Gulf Intracoastal Waterway
GMAQS	Gulf of Mexico Air Quality Study
GMFMC	Gulf of Mexico Fishery Management Council
GOADS	Gulfwide Offshore Activities Data System
GOM	Gulf of Mexico
GOMESA	Gulf of Mexico Energy Security Act of 2006
GS	Geological Survey (also: USGS)
H_2S	hydrogen sulfide
ha	hectare
hr	hour
i.e.	specifically
IATAP	Interagency Alternative Technology Assessment Program
in	inch

ITOPF	International Tanker Owners Pollution Federation Limited
ITS	Incidental Take Statement
JIP	Joint Industry Project
kg	kilogram
km	kilometer
kn	knot
LA	Louisiana
LA Hwy 1	Louisiana Highway 1
LACPR	Louisiana Coastal Protection and Restoration
lb	pound
LC_{50}	lethal concentration for 50 percent of the test population
LCA	Louisiana Coastal Area
LMA	labor market area
LMRP	lower marine riser package
LNG	liquefied natural gas
m	meter
MARAD	U.S. Department of Transportation Maritime Administration
MARPOL	International Convention for the Prevention of Pollution from Ships
Mcf	thousand cubic feet
mg	milligram
mg/L	milligrams per liter
mi	mile
ml/L	milliliter per liter
mm	millimeter
MMbbl/d	million barrels per day
MMcf	million cubic feet
MMPA	Marine Mammal Protection Act of 1972
MMS	Minerals Management Service
MOA	Memorandum of Agreement
MODU	mobile offshore drilling unit
MOU	Memorandum of Understanding
mph	miles per hour
Multisale EIS	*Gulf of Mexico OCS Oil and Gas Lease Sales: 2003-2007; Central Planning Area Sales 185, 190, 194, 198, and 201; Western Planning Area Sales 187, 192, 196, and 200; Final Environmental Impact Statement; Volumes I and II*
MWCC	Marine Well Containment Company
N.	north
n.d.	no date
NAAQS	National Ambient Air Quality Standards
NACE	National Association of Corrosion Engineers
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NGMCS	Northern Gulf of Mexico Continental Slope Study
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
nmi	nautical-mile
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent to Prepare an EIS
NOS	National Ocean Service
NPDES	National Pollutant and Discharge Elimination System
NPR	Notice of Proposed Rulemaking

NPS	National Park Service
NRC	National Research Council
NRDA	Natural Resource Damage Assessment
NTL	Notice to Lessees and Operators
NUT	new or unusual technology
O_3	ozone
OBF	oil-based fluids
OBM	oil-based muds
OCD	Offshore and Coastal Dispersion Model
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
ODMDS	ocean dredged-material disposal sites
OIG	Office of the Inspector General
OPA	Oil Pollution Act of 1990
OSAT	Operational Science Advisory Team
OSFR	oil-spill financial responsibility
OSHA	Occupational Safety and Health Administration
OSRA	Oil Spill Risk Analysis
OSRP	oil-spill response plans
OSV	offshore supply/service vessels
P.L.	Public Law
PAH	polycyclic aromatic hydrocarbon
pH	potential of hydrogen
PINC	Potential Incident of Noncompliance
PM	particulate matter
ppb	part per billion
ppm	parts per million
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
psu	practical salinity unit
QOCSR	qualified OCS revenues
ROD	Record of Decision
ROTAC	Regional Operations Technology Assessment Committee
ROV	remotely operated vehicle
RP	Recommended Practice
RPM	reasonable and prudent measure
RRT	Regional Response Team
RTR	Rigs-to-Reef
S.	south
SAV	submerged aquatic vegetation
SBF	synthetic-based fluids
SBM	synthetic-based muds
SCAT	Shoreline Cleanup and Assessment Team
Secretary	Secretary of the Interior
SEMS	Safety and Environmental Management System
SO_2	sulphur dioxide
SO_x	sulphur oxides
sp.	species
spp.	multiple species
Stat.	Statute
STOF-THPO	Seminole Tribe of Florida-Tribal Historic Preservation Officer
TA&R	Technology Assessment & Research Program
Tcf	trillion cubic feet
TGLO	Texas General Land Office
TX	Texas

U.S.	United States
U.S.C.	United States Code
UIC	Unified Incident Command
UME	unusual mortality event
USCG	U.S. Coast Guard (also: CG)
USDOC	U.S. Department of Commerce
USDOD	U.S. Department of Defense
USDOE	U.S. Department of the Energy (also: DOE)
USDOI	U.S. Department of the Interior (also: DOI)
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey (also: GS)
VOC	volatile organic compounds
VSP	vertical seismic profiling
W.	west
WAF	water accommodated fraction
WBF	water-based fluids
WPA	Western Planning Area
WSF	water soluble fraction
yd	yard
yr	year

CHAPTER 1

THE PROPOSED ACTION

1. THE PROPOSED ACTION

1.1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed Federal action is to offer for lease certain Outer Continental Shelf (OCS) blocks located in the Western Planning Area (WPA) in the Gulf of Mexico (GOM) (**Figure 1-1**) that may contain economically recoverable oil and gas resources. Under the *Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012* (5-Year Program; USDOI, MMS, 2007c), it was proposed that two GOM sales would be held each year—one in the WPA and one in the Central Planning Area (CPA). Proposed Lease Sale 218 in the WPA is the last sale in this planning area of the 5-Year Program and will provide qualified bidders the opportunity to bid on blocks in the Gulf of Mexico OCS in order to explore, develop, and produce oil and natural gas.

This Supplemental Environmental Impact Statement (EIS) was prepared because of the potential changes to baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the *Deepwater Horizon* (DWH) event between April 20 and July 15, 2010 (the period when oil flowed from the Macondo well in Mississippi Canyon Block 252 [**Figure 1-2**]); (2) the potentially acute impacts that have been reported or surveyed since that time; and (3) any new information that may be available since publication of the Multisale EIS or the 2009-2012 Supplemental EIS. The environmental resources that may be impacted include sensitive coastal environments, offshore benthic resources, marine mammals, sea turtles, coastal and marine birds, endangered and threatened species, and fisheries. This Supplemental EIS analyzes the potential impacts of the proposed action on the marine, coastal, and human environments. It is important to note that this Supplemental EIS was prepared using the best information that was publicly available at the time this document was prepared.

The need for the proposed action is to further the orderly development of OCS resources. Oil serves as the feedstock for liquid hydrocarbon products; among them gasoline, aviation and diesel fuel, and various petrochemicals. Oil from the WPA would help reduce the Nation's need for oil imports and lessen a growing dependence on foreign oil. The United States (U.S.) consumed 19.5 million barrels (bbl) of oil per day in 2009 (USDOE, Energy Information Administration, 2010a). Altogether, net imports of crude oil and petroleum products (imports minus exports) accounted for 51 percent of our total petroleum consumption in 2009. The U.S. crude oil imports stood at 9.0 million bbl per day in 2009. Petroleum product imports were 2.7 million bbl per day in 2009. Exports totaled 2.0 million bbl per day in 2009, mainly in the form of distillate fuel oil, petroleum coke, and residual fuel oil. Our biggest supplier of crude oil and petroleum product imports was Canada (21.2%), with countries in the Persian Gulf being the second largest source (17%) in 2009 (USDOE, Energy Information Administration, 2010b). Oil produced from the WPA would reduce the environmental risks associated with transoceanic oil tankering from sources overseas.

In 2009, the U.S. consumed approximately 22.8 trillion cubic feet (Tcf) of natural gas from all sources (USDOE, Energy Information Administration, 2011a). In 2009, the Gulf Coast States used approximately 6.4 Tcf of natural gas (USDOE, Energy Information Administration, 2011a). In 2008, 11.7 percent of U.S. natural gas resources were imported, mostly from Canada (USDOE, Energy Information Administration, 2010c). In 2009, 88 percent of net imports came by pipeline, primarily from Canada, and 12 percent came by liquefied natural gas (LNG) tankers carrying gas from five different countries (USDOE, Energy Information Administration, 2010d). Natural gas is an important feedstock for domestic industries engaged in the manufacture or formulation of fertilizers, pharmaceuticals, plastics, and packaging.

The Outer Continental Shelf Lands Act of 1953 (OCSLA), as amended (43 U.S.C. 1331 et seq. (2008)), established Federal jurisdiction over submerged lands seaward of State boundaries. Under the OCSLA, the Department of the Interior (DOI) is required to manage the leasing, exploration, development, and production of oil and gas resources on the Federal OCS. The Secretary of the Interior (Secretary) oversees the OCS oil and gas program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained. The OCSLA empowers the Secretary to grant leases to the highest qualified responsible bidder(s) on the basis of sealed competitive bids and to formulate such regulations as necessary to carry out the provisions of the Act. The Secretary has designated the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) as the agency responsible for the mineral leasing of submerged OCS lands and for the supervision of offshore operations after lease issuance, in accordance with the provisions of the OCSLA.

At the completion of the National Environmental Policy Act (NEPA) process, the Secretary will decide if proposed WPA Lease Sale 218 will take place. In the NEPA implementing regulations (40 CFR 1508.28), "tiering" refers to the coverage of general matters in a broader EIS (such as national program) with subsequent narrower statements of environmental analyses (such as regional action). Tiering is appropriate in this instance as broader program issues have already been subjected to analysis, and this Supplemental EIS is more narrowly focused on the site-specific statement or analysis for proposed WPA Lease Sale 218. This Supplemental EIS tiers from the following EIS's: the *Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012, Final Environmental Impact Statement* (5-Year Program EIS; USDOI, MMS, 2007a), which defined the national program; the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222, Final Environmental Impact Statement* (Multisale EIS; USDOI, MMS, 2007b), which defined the 5-Year Program in the GOM; and the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218, Final Supplemental Environmental Impact Statement* (2009-2012 Supplemental EIS; USDOI, MMS, 2008a), which was required after passage of the Gulf of Mexico Energy Security Act of 2006 (GOMESA).

1.2. DESCRIPTION OF THE PROPOSED ACTION

The proposed action is BOEMRE's holding of the one remaining oil and gas lease sale in the WPA as scheduled under the current 5-Year Program. Federal regulations allow for several related or similar proposals to be analyzed in one EIS (40 CFR 1502.4). The BOEMRE has decided to prepare a Supplemental EIS for the remaining WPA lease sale in the 5-Year Program.

Proposed WPA Lease Sale 218

Proposed WPA Lease Sale 218 is scheduled to be held in late 2011 or early 2012. The WPA sale area encompasses about 28.7 million acres (ac) mostly located beyond 3 leagues (10 miles [mi]; 16 kilometers [km]) offshore Texas and extends seaward to the limits of the United States jurisdiction over the continental shelf in water depths up to approximately 3,346 meters (m) (10,978 feet [ft]) (**Figure 1-1**). This proposed WPA lease sale would offer for lease all unleased blocks in the WPA for oil and gas operations, with the following exceptions:

(1) whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary; and

(2) whole and partial blocks that lie within the former Western Gap portion of the 1.4-nautical-mile (nmi) buffer zone north of the continental shelf boundary between the U.S. and Mexico.

The estimated amount of resources projected to be developed as a result of this proposed WPA lease sale is 0.222-0.423 billion barrels of oil (BBO) and 1.495-2.647 Tcf of gas. The proposed WPA lease sale includes proposed lease stipulations designed to reduce environmental risks, which are discussed in **Chapter 2.3**.

1.3. REGULATORY FRAMEWORK

Federal laws mandate the OCS leasing program (i.e., Outer Continental Shelf Lands Act) and the environmental review process (i.e., NEPA). Several Federal statutes and their implementing regulations establish specific consultation and coordination processes with Federal, State, and local agencies (i.e., Coastal Zone Management Act [CZMA], National Historic Preservation Act [NHPA], Endangered

Species Act [ESA], the Magnuson-Stevens Fishery Conservation and Management Act, and the Marine Mammal Protection Act [MMPA]). In addition, the OCS leasing process and all activities and operations on the OCS must comply with other applicable Federal, State, and local laws and regulations. On December 20, 2006, President Bush signed into law GOMESA, which made available two new areas in the GOM for leasing, placed a moratorium on other areas in the GOM, and increased the distribution of offshore oil and gas revenues to coastal States. The following major, applicable Federal laws and regulations are summarized in *OCS Regulatory Framework for the Gulf of Mexico Region* (Matthews and Cameron, 2010):

Regulation or Law	Citation
Outer Continental Shelf Lands Act	43 U.S.C. 1331 et seq.
National Environmental Policy Act of 1969	42 U.S.C. 4321-4347 40 CFR 1500-1508
Coastal Zone Management Act of 1972	16 U.S.C. 1451 et seq., 15 CFR 930.76
Endangered Species Act of 1973	16 U.S.C. 1631 et seq.
Magnuson-Stevens Fishery Conservation and Management Act	16 U.S.C. 1251 et seq.
Essential Fish Habitat	1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation	50 CFR 600.905-930
Marine Mammal Protection Act	16 U.S.C. 1361 et seq.
Clean Air Act	42 U.S.C. 7401 et seq., 40 CFR 55
Clean Water Act	Amendment to Federal Water Pollution Control Act of 1972
Clean Water Act—National Pollutant Discharge Elimination System	Section 316(b) of the Clean Water Act
Harmful Algal Bloom and Hypoxia Research and Control Act	P.L. 105-383
Oil Pollution Act of 1990	33 U.S.C. 2701 et seq., Executive Order 12777
Comprehensive Environmental Response, Compensation, and Liability Act of 1980	42 U.S.C. 9601 et seq.
Resource Conservation and Recovery Act	42 U.S.C. 6901 et seq.
Marine Plastic Pollution Research and Control Act	33 U.S.C. 1901 et seq.
National Fishing Enhancement Act of 1984	33 U.S.C. 2601 et seq.
Fishermen's Contingency Fund	43 U.S.C. 1841-1846
Ports and Waterways Safety Act of 1972	33 U.S.C. 1223 et seq.
Marine and Estuarine Protection Acts	33 U.S.C. 1401 et seq.
Marine Protection, Research, and Sanctuaries Act of 1972	P.L. 92-532
National Estuarine Research Reserves	16 U.S.C. § 1461, Section 315
National Estuary Program	P.L. 104-4
Coastal Barrier Resources Act	16 U.S.C. 3501 et seq.
National Historic Preservation Act	16 U.S.C. 470 et seq.
Rivers and Harbors Act of 1899	33 U.S.C. 401 et seq.
Occupational Safety and Health Act of 1970	29 U.S.C. 651-678q
Energy Policy Act of 2005	P.L. 109-58
Gulf of Mexico Energy Security Act of 2006	P.L. 109-432

Marine Debris Research, Prevention, and Reduction Act	P.L. 109-449
American Indian Religious Freedom Act of 1978	P.L. 95-341, 42 U.S.C. 1996 and 1996a
Federal Aviation Act of 1958	Federal Aviation Act of 1958 was repealed by the recodification of 49 U.S.C. (P.L. 103-272)
Migratory Bird Treaty Act of 1918	16 U.S.C. 703-712; Ch. 128; 07/13/1918; 40 Stat. 755
Submerged Lands Act of 1953	43 U.S.C. §§ 1301-1315 (2002)
49 U.S.C. 44718: Structures Interfering with Air Commerce	49 U.S.C. 44718
U.S. Coast Guard Regulations	
Marking of Obstructions	
Executive Order 11988: Floodplain Management	42 FR 26951 (1977), amended by Executive Order 12148 (7/20/79)
Executive Order 11990: Protection of Wetlands	42 FR 26961 (1977), amended by Executive Order 12608 (9/9/87)
Executive Order 12114: Environmental Effects Abroad	44 FR 1957 (1979)
Executive Order 12898: Environmental Justice	59 FR 5517 (1994)
Executive Order 13007: Indian Sacred Sites	61FR26771-26772(1996)
Executive Order 13089: Coral Reef Protection	63FR32701-32703(1998)
Executive Order 13175: Consultation and Coordination with Indian Tribal Governments	65 FR 67249-67252 (2000)
Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds	66 FR 3853 (2001)

1.3.1. Rule Changes following the *Deepwater Horizon* Event

In the aftermath of the DWH event on April 20, 2010, President Obama directed the Secretary of the Interior ("Secretary") to report within 30 days on what, if any, additional precautions, technologies, and procedures should be required on the OCS to improve the safety of oil and gas development on the OCS. In response to this directive, the Department of the Interior (DOI) prepared the report, *Increased Safety Measures for Energy Development on the Outer Continental Shelf*. The "30-Day Report" or "Safety Measures Report" was delivered to the Secretary and made public on May 27, 2010 (USDOI, 2010).

On a separate track and beginning long before the DWH event, this Agency published an Advanced Notice of Proposed Rulemaking (ANPR) (*Federal Register*, 2006a) on May 22, 2006, to solicit ideas for adoption of the American Petroleum Institute (API) Recommended Practice (RP) 75 containing recommendations for development of a Safety and Environmental Management System (SEMS) for OCS operations and facilities (API, 2004). This Agency published a Notice of Proposed Rulemaking (NPR) on June 17, 2009 (*Federal Register*, 2009a), based on comments received on the 2006 ANPR. The Agency was in the process of finalizing the rule when the DWH event (Macondo spill) took place. The final rule (*Federal Register*, 2010a) was published on October 15, 2010, requiring full implementation of a SEMS program as recommended by API RP 75.

On May 28, 2010, the Secretary directed this Agency to exercise its authority under the OCSLA to suspend certain drilling activities in water depths of 500 ft (152 m) and deeper for a period of up to 6 months. The May 28th suspension was intended to provide sufficient time to (1) ensure that drilling operations in conditions similar to those associated with the DWH event operate in a safe manner when drilling resumes, (2) account for the expected timeline for killing the Macondo well so that the extensive spill-response resources directed toward the spill would be available in the event of other spill events, and (3) provide adequate time to obtain input from ongoing investigations of the accident and to develop and promulgate regulations that address issues described in the Safety Measures Report.

On June 22, 2010, the United States Federal District Court in the Eastern District of Louisiana enjoined enforcement of the May 28th suspension. On July 12, 2010, the Secretary issued a decision memorandum rescinding the May 28th suspension and imposing a second suspension of certain drilling operations in deep water. This suspension was originally announced to be effective until November 30, 2010. The July 12th suspension applied, with certain exceptions, to the drilling of wells using a subsea blowout preventer (BOP) or a surface BOP on a floating facility. Three primary issues supported this temporary pause in drilling operations. The suspension (1) allowed time for BOEMRE to implement appropriate workplace and drilling safety measures; (2) was intended to provide BOEMRE, the industry, and others time to develop strategies and methods of containment of wild wells in deep water; and (3) was necessary to ensure that appropriate and sufficient response resources would be available in the event of another major oil spill.

The BOEMRE reduced the duration of the July 12, 2010, suspension insofar as it applies to deepwater development drilling operations using a subsea BOP or a surface BOP on a floating facility and wrote an environmental assessment with a Finding of No Significant Impact related to the early lifting of the suspension (USDOI, BOEMRE, 2010a). On October 12, 2010, the July 12th suspension was lifted in its entirety. After October 12, 2010, BOEMRE began to review and approve pending and future applications for permits to drill deepwater development wells using a subsea BOP or a surface BOP on a floating facility. Operators are still required to complete the documentation required to certify to BOEMRE that they are ready to re-initiate their projects.

The BOEMRE has addressed the three issues posed in the July 12, 2010, activity suspension through multiple venues. The BOEMRE has collected a large amount of information through public hearings and other meetings held specifically on the DWH event and through public comments on rulemaking efforts. The information collection, review, and analysis efforts resulted in new regulations, planned Notices to Lessees and Operators (NTL's), and BOEMRE procedures that address drilling safety, oil-spill response, and enhanced inspection procedures. These regulations, NTL's, and procedures were not in effect at the time of the DWH event, but they will apply to all future applicable drilling activities. The regulations, NTL's, and procedures include the following:

- NTL 2010-N06, "Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS," effective June 18, 2010 ("Plans NTL").
- NTL 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources," effective November 8, 2010 ("Certification NTL").
- The Drilling Safety Rule, Interim Final Rule to Enhance Safety Measures for Energy Development on the Outer Continental Shelf ("Drilling Safety Rule") (*Federal Register,* 2010b). This rule strengthens requirements for safety equipment, well control systems, and blowout prevention practices on offshore oil and gas operations.
- The SEMS Rule on Safety and Environmental Management Systems ("SEMS Rule") (*Federal Register,* 2010a). This rule requires operators to develop and implement a comprehensive SEMS for identifying, addressing, and managing operational safety hazards and impacts; promoting both human safety and environmental protection; and improving workplace safety by reducing the risk of human error.
- Enhanced Inspection Procedures. The BOEMRE is developing plans and schedules for conducting safety inspections of all deepwater drilling facilities. These plans and schedules will be implemented upon the recommencement of deepwater drilling operations.

Drilling Safety Rule

The BOEMRE determined issuance of an interim rule was needed; this rule implements the recommendations from the 30-Day Report considered by the Secretary to be the most important for safe resumption of offshore drilling operations. On October 14, 2010, the interim final rule was published in the *Federal Register* (2010b), together with a discussion of the comments that had been received by the Secretary in the period leading up to promulgation of the rule. The interim rulemaking revises selected sections of 30 CFR 250 Subparts D, E, F, O, and Q. Only a portion of the proposed changes in Subpart D add material capital or operating costs (some of which may be significant). For example, identical costly new requirements for subsea function testing of remotely operated vehicle (ROV) intervention during drill operations (Subpart D) apply to well completion (Subpart E) and workover (Subpart F) operations.

Table 1-1 compares the previous 30 CFR 250 Subpart D requirements with the new regulations. Those changes that impose significant costs include (1) seafloor function testing of ROV intervention and deadman systems (30 CFR 250.449(j) and (k), 30 CFR 250.516(d) and 250.616(h)); (2) negative pressure testing of individual casing strings (30 CFR 250.423(c)); (3) use of dual mechanical barriers for the final casing string (30 CFR 250.420(b)); (4) professional engineer certification that the well design is appropriate for expected wellbore conditions (30 CFR 250.420(a)); (5) retrieval and testing of BOP after a shear ram has been activated in a well-control situation (30 CFR 250.451(i)); and (6) third-party certification that the shear rams will shear drill pipe under maximum anticipated pressure (30 CFR 250.416(e)).

Subsea ROV and Deadman Function Testing—Drilling

Previous regulations at 30 CFR 250.449(b) required a stump test of the subsea BOP system. In a stump test, the subsea BOP system is placed on a simulated wellhead (the stump) on the rig floor. The BOP system is tested on the stump to ensure that the BOP is functioning properly. The new regulatory section at 30 CFR 250.449(j) requires that all ROV intervention functions on the subsea BOP stack must be tested during the stump test and one set of rams must be tested by an ROV on the seafloor.

Autoshear and deadman control systems activate during an accidental disconnect or loss of power, respectively. The new regulatory section at 30 CFR 250.449(k) requires that the autoshear and deadman systems be function-tested during the stump test, and the deadman system tested during the initial test on the seafloor. The initial test on the seafloor is performed as soon as the BOP is attached to the subsea wellhead.

These new requirements confirm that a well will be secured in an emergency situation and prevent a possible loss of well control. The ROV test requirement ensures that the dedicated ROV has the capacity to close the BOP functions on the seafloor. The deadman-switch test on the seafloor verifies that the wellbore closes automatically if both hydraulic pressure and electrical communication are lost with the rig.

The initial test on the seafloor for one set of rams and the deadman system is not currently an industry standard practice and will incur lost rig time. The addition of autoshear and deadman systems stump testing incurs additional rig time, but we do not expect the ROV intervention function stump testing to significantly increase testing time. Some operators currently simulate the hydraulic flow of an ROV to function test the BOP stack, while others use an actual ROV to test the BOP stack; this regulation requires the use of an ROV during the stump test.

The BOEMRE conducted a survey to investigate the potential impact of subsea ROV testing. Several drilling contractors, lease operators, and equipment manufacturers were asked: "How long would it take to function test the ROV to verify that the ROV could be used to close one set of blind-shear rams, one set of pipe rams, and disconnect the lower marine riser package (LMRP)?" Results averaged about 24 hours of lost rig time to perform these subsea tests. However, the interim regulation only requires one set of rams and the deadman system to be tested on the seafloor, not disconnecting the LMRP. The LMRP disconnect is estimated to require more time than testing the deadman system alone. We did not ask about the autoshear and deadman stump test requirements in our survey. We estimate that performing both the autoshear and deadman stump tests take close to the same time required to test the LMRP seafloor disconnect. The regulation does not affect platform rigs or shallow wells since they do not use subsea BOP's or ROV's.

Subsea ROV Function Testing—Workover/Completions

Previous regulations did not require subsea ROV function testing of the BOP during workover or completions operations. The new regulatory sections 30 CFR 250.516(d)(8) and 250.616(h)(1) require testing of ROV intervention functions and the autoshear/deadman systems during the stump test, and a function test of at least one set of rams and the deadman system on the seafloor. These sections extend the requirements added to deepwater drilling operations (discussed in the previous section) to well completion operations and workover operations using a subsea BOP stack. Successful exploratory wells are typically temporarily abandoned until additional equipment is installed to produce the reservoir. When the operator is preparing to produce the well, it is often completed using a different rig or redeployment of the original rig. The BOEMRE data show that two-thirds of deepwater wells drilled are exploratory wells, and approximately 23 percent of exploratory wells are completed.

Negative Pressure Tests

The previous regulation at 30 CFR 250.423 required a positive pressure test for each string of casing, except for the drive or structural casing string. This test confirms that fluid from the casing string is not flowing into the formation. The new regulatory section at 30 CFR 250.423(c) requires that a negative pressure test be conducted for all intermediate and production casing strings. This test will reveal whether gas or fluid from outside the casing is flowing into the well and ensures that the casing and cement provide a seal. Maintenance of pressure under both tests ensures proper casing installation and the integrity of the casing and cement. Based on in-house expertise, we estimate each new negative pressure test will take approximately 90 minutes for each casing string. We also estimate that, on average, deepwater wells use one production and four intermediate casing strings and that shallow wells use one production and two intermediate casing strings.

Installation of Dual Mechanical Barriers

Previous regulations did not require the installation of dual mechanical barriers. The new regulatory section at 30 CFR 250.420(b)(3) requires the operator install dual mechanical barriers in addition to cement barriers for the final casing string. These barriers prevent hydrocarbon flow in the event of cement failure at the bottom of the well. The operator must document the installation of the dual mechanical barriers and submit this documentation to BOEMRE within 30 days after installation. These new requirements ensure that the best casing and cementing design will be used for a specific well. Dual mechanical barriers may include two float valves or one float valve and one mechanical plug. Based on in-house expertise, BOEMRE estimates that all wells will require a second mechanical barrier.

Professional Engineer Certification for Well Design

Previous regulations at 30 CFR 250.420(a) specified well casing and cementing requirements but did not require verification by a Registered Professional Engineer. The new regulatory section at 30 CFR 250.420(a)(6) requires that well casing and cementing specifications must be certified by a Registered Professional Engineer. The Registered Professional Engineer will verify that the well casing and cementing design is appropriate for the purpose for which it is intended under expected wellbore conditions. This verification adds assurance that the appropriate design is used for the well, thus decreasing the likelihood of a blowout.

Emergency Cost of Activated Shear Rams

Previous regulations did not address BOP inspection following use of the blind-shear ram or casing shear ram. The new regulatory section at 30 CFR 250.451(i) requires that, if a blind-shear ram or casing shear ram is activated in a well control situation where the pipe is sheared, the BOP stack must be retrieved, fully inspected, and tested. This provision ensures the integrity of the BOP and that the BOP will still function and hold pressure after the event. This activity, when triggered, will add about 13 days to drilling time. According to a Det Norske Veritas study, out of 5,611 deepwater wells, there were 12 situations where either the blind-shear or casing shear ram was activated; this implies one activation for every 515 wells drilled.

Third Party Shearing Verification

Regulation 30 CFR 250.416(e) requires information verifying that BOP blind-shear rams are capable of cutting through any drill pipe in the hole under maximum anticipated conditions. This regulation has been modified to require the BOP verification be conducted by an independent third party. The independent third party provides an objective assessment that the blind-shear rams can shear any drill pipe in the hole if the shear rams are functioning properly. This confirmation will be required for both subsea and surface BOP's. NTL 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources," clarifies how the regulations apply to operators conducting operations using subsea BOP's or surface BOP's on floating facilities. The NTL informs these operators that a statement, signed by an authorized company official stating that the operator will conduct all authorized activities in compliance with all applicable regulations, including the increased safety measures regulations, should be submitted with each application for a well permit.

30 CFR 250 Subpart S—Safety and Environmental Management System (SEMS)

Following the DWH event, BOEMRE promulgated a final rule that requires operators to develop and implement a SEMS for OCS operations (*Federal Register*, 2010a). As explained in a BOEMRE fact sheet (USDOI, BOEMRE, 2010b), a SEMS is a comprehensive management program for identifying, addressing, and managing operational safety hazards and impacts, with the goal of promoting both human safety and environmental protection. The SEMS program rule is a workplace safety program rule covering all offshore oil and gas operations in Federal waters and makes mandatory the previously voluntary practices in the API RP 75. A mandatory oil and gas SEMS program is intended to enhance the safety and environmental protection of oil and gas drilling operations on the OCS. The SEMS Rule is implemented in the new Subpart S of 30 CFR 250.1900-1915. The Final Rule became effective on November 15, 2010, and must be implemented by November 15, 2011.

This Agency was preparing to finalize the SEMS Rule before the DWH event. During the DWH event, BOEMRE continued to carefully analyze the proposed rule, which proposed making mandatory the essential components of API RP 75. The BOEMRE determined that it was appropriate to incorporate all of API RP 75. The BOEMRE intends to address additional safety management system provisions considered appropriate in light of the DWH event in additional future rulemakings.

Implementation of the SEMS Rule has the following benefits: (1) it will provide oversight and enforcement of SEMS provisions (Although many large operators on the OCS currently have a SEMS program, the voluntary nature of the programs limits their effectiveness.); (2) it will impose the requirement for a SEMS program on all OCS operators; (3) it will address human factors behind accidents not reached by previous regulations; and (4) it will provide a flexible approach to systematic safety that can keep up with evolving technologies.

The 13 elements of API RP 75 that 30 CFR 250 Subpart S now make mandatory are as follows:

- defining the general provisions for implementation, planning and management review, and approval of the SEMS program;
- identifying safety and environmental information needed for any facility such as design data, facility process such as flow diagrams, and mechanical components such as piping and instrument diagrams;
- requiring a facility-level risk assessment;
- addressing any facility or operational changes including management changes, shift changes, contractor changes;
- evaluating operations and written procedures;
- specifying safe work practices, manuals, standards, and rules of conduct;
- training, safe work practices, and technical training, including contractors;

- defining preventive maintenance programs and quality control requirements;
- requiring a pre-startup review of all systems;
- responding to and controlling emergencies, evacuation planning, and oil-spill contingency plans in place and validated by drills;
- investigating incidents, procedures, corrective action, and follow-up;
- requiring audits every 4 years, to an initial 2-year reevaluation and then subsequent 3-year audit intervals; and
- specifying records and documentation that describes all elements of the SEMS program.

1.4. PRELEASE PROCESS

Scoping for this Supplemental EIS was conducted in accordance with Council on Environmental Quality (CEQ) regulations implementing NEPA. Scoping provides those with an interest in the OCS Program an opportunity to provide comments on the proposed action. In addition, scoping provides BOEMRE an opportunity to update the Gulf of Mexico OCS Region's environmental and socioeconomic information base. The public scoping process for this Supplemental EIS began November 10, 2010, with publication of the Notice of Intent to Prepare a Supplemental EIS (NOI) and an announcement for three scoping meetings (*Federal Register*, 2010c). A 45-day comment period was established. A subsequent NOI was published in the *Federal Register* on November 16, 2010, to correct clerical errors in the first notice, and it established January 3, 2011, for the closing of the comment period (*Federal Register*, 2010d). Between the first and second NOI's, the dates and locations for scoping meetings announced on November 10, 2010, did not change.

Although the scoping process for the current 5-Year Program was formally initiated on March 7, 2006, with the publication of the NOI in the *Federal Register*, scoping efforts and other coordination meetings have proceeded throughout this NEPA process. Scoping and coordination opportunities are available during BOEMRE's requests for information, comments, input, and review on other BOEMRE NEPA documents.

The Area Identification decision was made for all proposed lease sales in the current 5-Year Program on August 10, 2006. The Area Identification is an administrative prelease step that describes the geographical area of the proposed action (proposed lease sale area) and identifies the alternatives, mitigating measures, and issues to be analyzed in the appropriate NEPA document. As mandated by NEPA, this Supplemental EIS analyzes the potential impacts of the proposed action on the marine, coastal, and human environments.

Scoping meetings were held on November 16 in New Orleans at the Louis Armstrong Airport Hilton, on November 17 in Houston at the George Bush Airport Marriott, and on November 18 in Mobile at the Battle House Renaissance Mobile Hotel. Public notices were published on November 12 and 13, 2010, the weekend before the meetings, in these local papers: the *Times Picayune*; the *Houston Chronicle*; and the *Mobile Register*. Announcements were sent by U.S. mail to addressees on BOEMRE's Gulf of Mexico mailing list and were posted on the Internet. Letters were sent to the Governor's of the five Gulf Coast States announcing the scoping process on November 10, 2010. Federal, State, and local governments, along with other interested parties, were invited to send written comments to the Gulf of Mexico OCS Region on the scope of the Supplemental EIS. Comments were received in response to the NOI, and testimony was provided at the scoping meetings from Federal, State, local government agencies, interest groups, industry, businesses, and the general public on the scope of the Supplemental EIS, significant issues that should be addressed, alternatives that should be considered, and mitigation measures. All scoping meeting comments received were considered in the preparation of this Supplemental EIS. The comments (both verbal and written) have been summarized in **Chapter 5.3**.

The BOEMRE also conducted early coordination with appropriate Federal and State agencies and other concerned parties to discuss and coordinate the prelease process for the proposed lease sale and this Supplemental EIS. Key agencies and organizations included the U.S. Department of Commerce, National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS);

U.S. Department of Defense (USDOD or DOD); U.S. Coast Guard (USCG or CG); U.S. Environmental Protection Agency (USEPA); State Governors' offices; and industry groups.

The BOEMRE provided copies of the Draft Supplemental EIS for review and comment to public and private agencies, interest groups, and local libraries. To initiate the public review and comment period on the Draft Supplemental EIS, BOEMRE published a Notice of Availability (NOA) in the *Federal Register*. Additionally, public notices were mailed with the Draft Supplemental EIS and placed on the BOEMRE, Gulf of Mexico OCS Region's Internet website. In accordance with 30 CFR 256.26, BOEMRE held public hearings to solicit comments on the Draft Supplemental EIS. The hearings provided the Secretary with information from interested parties to help in the evaluation of potential effects of the proposed lease sale. Notices of the public hearings were included in the NOA, posted on the BOEMRE, Gulf of Mexico OCS Region's Internet website, and published in the *Federal Register* and local newspapers.

A consistency review will be performed and a Consistency Determination (CD) will be prepared for each affected State prior to the proposed lease sale. To prepare the CD's, BOEMRE reviews each State's Coastal Management Program (CMP) and analyzes the potential impacts as outlined in this Supplemental EIS, new information, and applicable studies as they pertain to the enforceable policies of each CMP. Based on the analyses, the BOEMRE Director makes an assessment of consistency, which is then sent to each State with the Proposed Notice of Sale (NOS). If a State objects with BOEMRE's CD, the State is required to do the following under CZMA: (1) indicate how the BOEMRE presale proposal is inconsistent with specific enforceable policies of the CMP (specify the enforceable policy with citation); (2) describe alternative measures (if they exist) to bring the BOEMRE proposal into consistency with their CMP; or (3) describe the nature of the information requested and the necessity of such information to determine the consistency of the Federal agency activity with the enforceable policies of the management program. Unlike the consistency process for specific OCS plans and permits, there is not a procedure for administrative appeal to the Secretary of Commerce for a Federal CD for presale activities. In the event of a serious disagreement between a Federal agency and the State CMP regarding consistency of the proposed lease sale, either BOEMRE or the State may request mediation. The regulations provide for an opportunity to resolve any differences with the State, but CZMA allows BOEMRE to proceed with the lease sale despite any unresolved disagreements if the Federal agency clearly describes, in writing, to the State CMP how the activity is consistent to the maximum extent practicable. The Final Supplemental EIS will be published approximately 5 months prior to the proposed lease sale. To initiate the public review and 30-day minimum comment period on the Final Supplemental EIS, BOEMRE will publish a NOA in the *Federal Register*. The BOEMRE will provide copies of the Final Supplemental EIS for review and comment to public and private agencies, interest groups, and local libraries. Additionally, public notices will be mailed with the Final Supplemental EIS and placed on the BOEMRE, Gulf of Mexico OCS Region's Internet website.

After the end of the comment period, DOI will review the Supplemental EIS in consideration of all comments received on the Final Supplemental EIS. The Supplemental EIS is not a decision document. A Record of Decision (ROD), which is the last step in this NEPA process, will identify the alternative chosen.. The ROD will summarize the proposed action and the alternatives evaluated in the Supplemental EIS, the conclusions of the impact analyses, and other information considered in reaching the decision. All comments received on the Final Supplemental EIS will be addressed in the ROD. If the decision is to hold a lease sale, the ROD will be in the form of a Final NOS.

A Proposed NOS will become available to the public 4-5 months prior to the proposed lease sale. A notice announcing the availability of the Proposed NOS appears in the *Federal Register*, initiating a 60-day comment period. Comments received will be analyzed during preparation of the decision documents that are the basis for the Final NOS, including proposed lease sale configuration and terms and conditions.

If the decision by the Assistant Secretary of the Interior for Land and Minerals (ASLM) is to hold the proposed lease sale, a Final NOS will be published in its entirety in the *Federal Register* at least 30 days prior to the sale date, as required by the OCSLA. If the ASLM determines that the proposed lease sale will not move forward, then the Final NOS will not be published.

1.5. POSTLEASE ACTIVITIES

The BOEMRE is responsible for managing, regulating, and monitoring oil and natural gas exploration, development, and production operations on the Federal OCS to promote orderly development of mineral resources and to prevent harm or damage to, or waste of, any natural resource, any life or property, or the marine, coastal, or human environment. Regulations for oil, gas, and sulphur lease operations are specified in 30 CFR 250, 30 CFR 251, and 30 CFR 254.

Measures to minimize potential impacts are an integral part of the OCS Program. These measures are implemented through lease stipulations, operating regulations, NTL's, and project-specific requirements or approval conditions. These measures address concerns such as endangered and threatened species, geologic and manmade hazards, military warning and ordnance disposal areas, archaeological sites, air quality, oil-spill response planning, chemosynthetic communities, artificial reefs, operations in hydrogen sulfide (H_2S) prone areas, and shunting of drill effluents in the vicinity of biologically sensitive features. Standard mitigation measures in the Gulf of Mexico OCS include

- limiting the size of explosive charges used for structure removals;
- requiring placement explosive charges at least 15 ft (5 m) below the mudline;
- requiring site-clearance procedures to eliminate potential snags to commercial fishing nets;
- establishment of No Activity and Modified Activity Zones around high-relief live bottoms;
- requiring remote-sensing surveys to detect and avoid biologically sensitive areas such as low-relief live bottoms, pinnacles, and chemosynthetic communities; and
- requiring coordination with the military to prevent multiuse conflicts between OCS and military activities.

The BOEMRE issues NTL's to provide clarification, description, or interpretation of a regulation; guidelines on the implementation of a special lease stipulation or regional requirement; or convey administrative information. A detailed listing of current Gulf of Mexico OCS Region NTL's is available through the BOEMRE, Gulf of Mexico OCS Region's Internet website or through the Region's Public Information Office at (504) 736-2519 or 1-800-200-GULF.

Formal plans must be submitted to BOEMRE for review and approval before any project-specific activities, except for ancillary activities (such as geological and geophysical activities or studies that model potential oil and hazardous substance spills), can begin on a lease. Conditions of approval are mechanisms to control or mitigate potential safety or environmental problems associated with proposed operations. Conditions of approval are based on BOEMRE technical and environmental evaluations of the proposed operations. Comments from Federal and State agencies (as applicable) are also considered in establishing conditions. Conditions may be applied to any OCS plan, permit, right-of-use of easement, or pipeline right-of-way grant.

Some BOEMRE-identified mitigation measures are implemented through cooperative agreements or coordination with the oil and gas industry and Federal and State agencies. These measures include the NOAA Fisheries Service Observer Program to protect marine mammals and sea turtles when OCS structures are removed using explosives, labeling of operational supplies to track sources of accidental debris loss, development of methods of pipeline landfall to eliminate impacts to barrier beaches, and semiannual beach cleanup events.

The following postlease activity descriptions apply to the proposed lease sale area in the WPA.

Geological and Geophysical Activities

A geological and geophysical (G&G) permit must be obtained from BOEMRE prior to conducting off-lease geological or geophysical exploration or scientific research on unleased OCS lands or on lands under lease to a third party (30 CFR 251.4 (a) and (b)). Geological investigations include various seafloor sampling techniques to determine the geochemical, geotechnical, or engineering properties of the sediments.

Ancillary activities are defined in 30 CFR 250.105 with regulations outlined in 30 CFR 250.207 through 250.210. Ancillary activities are activities conducted on-lease and include G&G exploration and development G&G activities; geological and high-resolution geophysical, geotechnical, archaeological, biological, physical oceanographic, meteorological, socioeconomic, or other surveys; or various types of modeling studies. This Agency issued NTL 2009-G34, "Ancillary Activities," to provide updated guidance and clarification on conducting ancillary activities in the BOEMRE's Gulf of Mexico OCS Region. Operators should notify the BOEMRE, Gulf of Mexico OCS Region, Regional Supervisor, Field Operations in writing 30 days in advance before conducting any of the following types of ancillary activities related to a G&G exploration or development G&G activity:

- involving the use of an airgun or airgun array in water depths 200 m (656 ft) or greater, or in the Eastern Planning Area (EPA) of the GOM in any water depth;
- independent of water depth, involving the use of explosives as an energy source; and
- independent of water depth, including ocean-bottom cable surveys, node surveys, and time-lapse (4D) surveys.

Additionally, NTL 2009-G34 clarifies that the Gulf of Mexico OCS Region, Regional Supervisor, Field Operations should be notified in writing 15 days in advance before conducting the following types of other ancillary activities:

- involving the use of an airgun or airgun array in water depths 200 m (656 ft) or greater, or in the EPA of the GOM in any water depth;
- involving bottom disturbance, independent of water depth, including ocean-bottom cable surveys, node surveys, and time-lapse (4D) surveys; and
- a geotechnical evaluation involving piston-/gravity-coring or the recovery of sediment specimens by grab-sampling or similar technique and/or any dredging or other ancillary activity that disturbs the seafloor (including deployment and retrieval of bottom cables, anchors, or other equipment).

This NTL also provides guidance for each type of ancillary activity, the type and level of BOEMRE review, and follow-up, post-survey report requirements.

Seismic surveys are performed to obtain information on surface and near-surface geology and on subsurface geologic formations. Low-energy, high-resolution seismic surveys collect data on surficial geology used to identify potential shallow geologic or manmade hazards (e.g., faults or pipelines) for engineering and site planning for bottom-founded structures. The high-resolution surveys are also used to identify environmental and archaeological resources such as low-relief live-bottom areas, pinnacles, chemosynthetic community habitat, and shipwrecks. High-energy, deep-penetration, common-depth-point (CDP) seismic surveys obtain data about geologic formations thousands of feet below the seafloor. The two-dimensional (2D) and three-dimensional (3D) CDP data are used to map structure features of stratigraphically important horizons in order to identify potential hydrocarbon traps. They can also be used to map the extent of potential habitat for chemosynthetic communities. In some situations, a set of 3D surveys can be run over a time interval to produce a four-dimensional (4D), or "time-lapse," survey that could be used to characterize production reservoirs.

This Agency completed a programmatic environmental assessment (EA) on Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico OCS (CSA, 2004a). Upon receiving a complete G&G permit application, BOEMRE conducts a categorical exclusion review (CER), an EA, or an EIS in accordance with the G&G Programmatic EA's conclusions, NEPA guidelines, and other applicable BOEMRE policies. When required under an approved coastal management program, proposed G&G permit activities must receive State concurrence prior to BOEMRE permit approval.

Exploration and Development Plans

To ensure conformance with the OCSLA, other laws, applicable regulations, and lease provisions, and to enable BOEMRE to carry out its functions and responsibilities, formal plans (30 CFR 250.211 and 250.241) with supporting information must be submitted for review and approval by BOEMRE before an operator may begin exploration, development, or production activities on any lease. Supporting environmental information, archaeological reports, biological reports (monitoring and/or live-bottom survey), and other environmental data determined necessary must be submitted with an OCS plan. This information provides the basis for an analysis of both offshore and onshore impacts that may occur as a result of the activities. The BOEMRE may require additional specific supporting information to aid in the evaluation of the potential environmental impacts of the proposed activities. The BOEMRE can require amendment of an OCS plan based on inadequate or inaccurate supporting information. The 30 CFR 250 Subpart B regulations were revised to update the information that must be submitted and were published in the *Federal Register* on August 30, 2005 (Federal Register, 2005).

The OCS plans are reviewed by geologists, geophysicists, engineers, biologists, archaeologists, air quality specialists, oil-spill specialists, NEPA coordinators, and/or environmental scientists. The plans and accompanying information are evaluated to determine whether any seafloor or drilling hazards are present; that air and water quality issues are addressed; that plans for hydrocarbon resource conservation, development, and drainage are adequate; that environmental issues and potential impacts are properly evaluated and mitigated; and that the proposed action is in compliance with NEPA, CZMA, BOEMRE operating regulations, and other requirements. Federal agencies, including the U.S. Fish and Wildlife Service (FWS), NOAA Fisheries Service, USEPA, the U.S. Navy, the U.S. Air Force, and the USCG, may be consulted if the proposal has the potential to impact areas under their jurisdiction. Each Gulf Coast State has a designated CZM agency that takes part in the review process. The OCS plans are also made available to the general public for comment through the BOEMRE, Gulf of Mexico OCS Region's Public Information Office.

In response to increasing deepwater activities in the GOM, BOEMRE developed a comprehensive strategy to address NEPA compliance and environmental issues in the deepwater areas. A key component of that strategy was the completion of a Programmatic EA to evaluate the potential effects of the deepwater technologies and operations (USDOI, MMS, 2000). As a supplement to the Programmatic EA, this Agency prepared a series of technical papers that provide a summary description of the different types of structures that may be employed in the development and production of hydrocarbon resources in the deepwater areas of the GOM (Regg et al., 2000). The Programmatic EA and technical papers were used in the preparation of this Supplemental EIS.

On the basis of the BOEMRE reviews of the OCS plan, the findings of the proposal-specific CER, EA, or EIS, and other applicable BOEMRE studies and NEPA documents, the OCS plan is approved or disapproved by BOEMRE, or modified and resubmitted. Although very few OCS plans are ultimately disapproved, many must be amended prior to approval to fully comply with BOEMRE operating regulations and requirements, or other Federal laws, to address reviewing agencies' concerns, or to avoid potential hazards or impacts to environmental resources.

On May 12, 2008, this Agency issued NTL 2008-G06, "Remotely Operated Vehicle (ROV) Surveys in Deepwater." The NTL provides guidance for ROV surveys and reports in water depths greater than 400 m (1,312 ft). Twenty-one grid areas have been developed to ensure a broad and systematic analysis of deep water and to depict areas of biological similarity, primarily on the basis of benthic communities. The grid areas cover the WPA and CPA. Grids 18, 19, 20, and 21 have been designated as deepwater and ultra-deepwater grids (**Figure 1-3**).

Operators must submit a ROV survey plan with each Exploration Plan (EP) submitted in each grid area and with the Development Operations Coordination Document (DOCD) for the first surface structure proposed in each grid area. The following information must be included in a ROV survey plan:

- a statement that the operator is familiar with the ROV survey and reporting provisions outlined in the NTL;
- a brief description of the survey the operator plans to conduct, including timeframes, proposed transects, and the equipment that will be used; and

- a statement that the operator will make biological and physical observations as described in the NTL and the ROV survey form during two periods of operations—pre-spudding (survey performed from the facility) and post-drilling (prior to facility removal).

The BOEMRE will notify the operator whether or not to conduct the proposed ROV survey based on whether the grid area has already received adequate ROV survey coverage (as documented at http://www.gomr.boemre.gov/homepg/regulate/environ/ea_grid/ea_grid.asp).

Exploration Plans

An EP must be submitted to BOEMRE for review and approval before any exploration activities, except for preliminary activities (such as hazard surveys or geophysical surveys), can begin on a lease. The EP describes exploration activities, drilling rig or vessel, proposed drilling and well-testing operations, environmental monitoring plans, and other relevant information, and includes a proposed schedule of the exploration activities. Guidelines and environmental information requirements for lessees and operators submitting an EP are addressed in 30 CFR 250.211 and are further explained in NTL's 2008-G04, "Shallow Hazards Program," and 2009-G27, "Submitting Exploration Plans and Development Operations Coordination Documents." The NTL 2008-G04 provides guidance on information requirements and establishes the contents for OCS plans required by 30 CFR 250 Subpart B. The NTL 2010-N06, "Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS," effective June 18, 2010, rescinded the limitations set forth in NTL 2008-G04 regarding a blowout and worse-case discharge scenarios and provided national guidance regarding the content of information in a blowout and worse-case discharge scenario descriptions. The NTL 2009-G27 clarifies guidance for submitting OCS plans and DOCD's to the BOEMRE, Gulf of Mexico OCS Region.

After receiving an EP, BOEMRE determines if the plan is complete and adequate before technical and environmental reviews. The BOEMRE evaluates the proposed exploration activities for potential impacts relative to geohazards and manmade hazards (including existing pipelines), archaeological resources, endangered species, sensitive biological features, water and air quality, oil-spill response, State CZMA requirements, and other uses (e.g., military operations) of the OCS. The EP is reviewed for compliance with all applicable laws and regulations.

A CER or EA is prepared as documentation of the environmental review of the EP. The CER or EA is based on available information, which may include the geophysical report (for determining the potential for the presence of deepwater benthic communities); archaeological report; air emissions data; live-bottom survey and report; biological monitoring plan; and recommendations by the affected State(s), DOD, FWS, NOAA Fisheries Service, and/or internal BOEMRE offices. As part of the review process, each EP must contain a certification of consistency and the necessary data and information for the State to determine that the proposed activities comply with the enforceable policies of the States' approved CMP and that such activities will be conducted in a manner that is consistent with the CMP (16 U.S.C. 1456(c)(3)(A) and 15 CFR 930.76).

If the EP is approved, and prior to conducting drilling operations, the operator is required to submit and obtain approval for an Application for Permit to Drill (APD) (see *Wells* under *Permits and Applications* below).

Deepwater Operations Plans

In 1992, this Agency formed an internal Deepwater Task Force to address technical issues and regulatory concerns relating to deepwater (>1,000 ft; 305 m) operations and projects utilizing subsea technology. Based on the Deepwater Task Force's recommendation, an NTL (2000-N06) was at first developed that was incorporated into 30 CFR 250 Subpart B. The revisions to Subpart B were finalized August 30, 2005, and required operators to submit a Deepwater Operations Plan (DWOP) for all operations in deep water (400 m [1,312 ft] or greater) and all projects using subsea technology. DeepStar, an industry-wide cooperative workgroup focused on deepwater regulatory issues and critical technology development issues, worked closely with this Agency's Deepwater Task Force to develop the initial guidelines for the DWOP. The DWOP was established to address regulatory issues and concerns that were not addressed in the existing BOEMRE regulatory framework, and it is intended to initiate an early dialogue between BOEMRE and industry before major capital expenditures on deepwater and subsea projects are committed. Deepwater technology has been evolving faster than BOEMRE's ability to revise OCS regulations; the DWOP was established through the NTL process, which provides for a more timely and flexible approach to provide guidance on regulatory requirements and to keep pace with the expanding deepwater operations and subsea technology.

The DWOP is intended to address the different functional requirements of production equipment in deep water, particularly the technological requirements associated with subsea production systems, and the complexity of deepwater production facilities. The DWOP provides BOEMRE with information specific to deepwater equipment issues to demonstrate that a deepwater project is being developed in an acceptable manner as mandated in the OCSLA, as amended, and the BOEMRE operating regulations at 30 CFR 250. The BOEMRE reviews deepwater development activities from a total system perspective, emphasizing operational safety, environmental protection, and conservation of natural resources. The DWOP process is a phased approach that parallels the operator's state of knowledge about how a field will be developed. A DWOP outlines the design, fabrication, and installation of the proposed development/production system and its components. A DWOP will include structural aspects of the facility (fixed, floating, subsea); station-keeping (includes mooring system); wellbore, completion, and riser systems; safety systems; product removal or offtake systems; and hazards and operability of the production system. The DWOP provides BOEMRE with the information to determine that the operator has designed and built sufficient safeguards into the production system to prevent the occurrence of significant safety or environmental incidents. The DWOP, in conjunction with other permit applications, provides BOEMRE the opportunity to assure that the production system is suitable for the conditions in which it will operate.

This Agency recently completed a review of several industry-developed, recommended practices that address the mooring and risers for floating production facilities. The recommended practices address such things as riser design, mooring system design (station-keeping), and hazard analysis. Hazard analyses allow BOEMRE to be assured that the operator has anticipated emergencies and is prepared to address them, either through their design or through the operation of the equipment in question. This Agency released these clarifications of its requirements in recent NTL's: NTL 2009-G03, "Synthetic Mooring Systems"; NTL 2009-G11, "Accidental Disconnect of Marine Drilling Risers"; and NTL 2009-G13, "Guidelines for Tie-downs on OCS Production Platforms for Upcoming Hurricane Seasons."

Conservation Reviews

One of BOEMRE's primary responsibilities is to ensure development of economically producible reservoirs according to sound conservation, engineering, and economic practices as cited in 30 CFR 250.202(c), 250.203, 250.204, 250.205, 250.210, 250.296, 250.297, 250.298, 250.299, and 250.1101. Operators should submit the necessary information as part of their EP, initial and supplemental DOCD, and Conservation Information Document. Conservation reviews are performed to ensure that economic reserves are fully developed and produced, and that there is no harm to the ultimate recovery.

Development Operations and Coordination Documents

Before any development operations can begin on a lease in the proposed lease sale area, a DOCD must be submitted to BOEMRE for review and approval. A DOCD describes the proposed development activities, drilling activities, platforms or other facilities, proposed production operations, environmental monitoring plans, and other relevant information, and it includes a proposed schedule of development and production activities. Requirements for lessees and operators submitting a DOCD are addressed in 30 CFR 250.241-250.242, and information guidelines for DOCD's are provided in NTL's 2008-G04, 2009-G27, and 2010-N06.

After receiving a DOCD, BOEMRE performs technical and environmental reviews. The BOEMRE evaluates the proposed activity for potential impacts relative to geohazards and manmade hazards (including existing pipelines), archaeological resources, endangered species, sensitive biological features, water and air quality, oil-spill response, State CZMA requirements, and other uses (e.g., military operations) of the OCS. The DOCD is reviewed for compliance with all applicable laws and regulations.

A CER, EA, and/or EIS are prepared as documentation of the environmental review of a DOCD. The CER, EA, and/or EIS are based on available information, which may include the geophysical report (for determining the potential for the presence of deepwater benthic communities); archaeological report; air emissions data; live-bottom survey and report; biological monitoring plan; and recommendations by the affected State(s), DOD, FWS, NOAA Fisheries Service, and/or internal BOEMRE offices.

As part of the review process, the DOCD and related environmental analysis may be sent to the affected State(s) for a consistency review under the States' federally approved coastal management program. The OCSLA (43 U.S.C. 1345(a) through (d) and 43 U.S.C. 1351(a)(3)) and CZMA (16 U.S.C. 1456(c)(3)(A) and 15 CFR 930.76) provide for this coordination and consultation with the affected State and local governments concerning a DOCD.

New or Unusual Technologies

Technologies continue to evolve to meet the technical, environmental, and economic challenges of deepwater development. New or unusual technologies (NUT's) may be identified by the operator in its EP, DWOP, and DOCD or through BOEMRE's plan review processes. Some of the technologies proposed for use by the operators are actually extended applications of existing technologies and interface with the environment in essentially the same way as well-known or conventional technologies. These technologies are reviewed by BOEMRE for alternative compliance or departures that may trigger additional environmental review. Some examples of new technologies that do not affect the environment differently and that are being deployed in the OCS Program are synthetic mooring lines, subsurface safety devices, and multiplex subsea controls.

Some new technologies differ from established technologies in how they function or interface with the environment. These include equipment or procedures that have not been installed or used in Gulf of Mexico OCS waters. Having no operational history, they have not been assessed by BOEMRE through technical and environmental reviews. New technologies may be outside the framework established by BOEMRE regulations and, thus, their performance (safety, environmental protection, efficiency, etc.) has not been addressed by BOEMRE. The degree to which these new technologies interface with the environment and the potential impacts that may result are considered in determining the level of NEPA review that would be initiated.

The BOEMRE has developed a NUT's matrix to help facilitate decisions on the appropriate level of engineering and environmental review needed for a proposed technology. Technologies will be added to the NUT's matrix as they emerge, and technologies will be removed from the matrix as sufficient experience is gained in their implementation. From an environmental perspective, the matrix characterizes new technologies into three components: technologies that may affect the environment; technologies that do not interact with the environment any differently than "conventional" technologies; and technologies that BOEMRE does not have sufficient information to determine its potential impacts to the environment. In this later case, BOEMRE will seek to gain the necessary information from operators or manufacturers regarding the technologies to make an appropriate determination on its potential effects on the environment.

Alternative Compliance and Departures: The BOEMRE's project-specific engineering safety review ensures that equipment proposed for use is designed to withstand the operational and environmental condition in which it would operate. When an OCS operator proposes the use of technology or procedures not specifically addressed in established BOEMRE regulations, the operations are evaluated for alternative compliance or departure determination. Any new technologies or equipment that represent an alternative compliance or departure from existing BOEMRE regulation must be fully described and justified before they would be approved for use. For BOEMRE to grant alternative compliance or departure approval, the operator must demonstrate an equivalent or improved degree of protection as specified in 30 CFR 250.141. Comparative analysis with other approved systems, equipment, and procedures is one tool that BOEMRE uses to assess the adequacy of protection provided by alternative technology or operations. Actual operational experience is necessary with alternative compliance measures before BOEMRE would consider them as proven technology.

Emergency Plans

Criteria, models, and procedures for shutdown operations and the orderly evacuation of platforms and rigs for a pending hurricane have been in place in the Gulf of Mexico OCS for more than 30 years. (Such emergency plans are different from the oil-spill response plans described later in this chapter.) Operating experience from extensive drilling activities and more than 4,000 platforms during the 30-plus years of the Gulf of Mexico OCS Program have demonstrated the effectiveness and safety of securing wells and evacuating a facility in advance of severe weather conditions. Preinstallation efforts, historical experience with similar systems, testing, and the actual operating experience (under normal conditions and in response to emergency situations) are used to formulate the exact time needed to secure the wells and production facility and to evacuate it as necessary. Operators develop site-specific curtailment, securing, and evacuation plans that vary in complexity and formality by operator and type of activity. In general terms, all plans are intended to make sure the facility (or well) is secured in advance of a pending storm or developing emergency. The operating procedures developed during the engineering, design, and manufacturing phases of the project, coupled with the results (recommended actions) from hazard analyses performed, will be used to develop the emergency action and curtailment plans. Evacuation and production curtailment must consider a combination of factors, including the well status (drilling, producing, etc.) and the type and mechanics of wellbore operations. These factors are analyzed onsite through a decisionmaking process that involves onsite facility managers. The emphasis is on making real-time, situation-specific decisions and forecasting based on available information. Details of the shut-in criteria and various alerts are addressed on a case-by-case basis.

Plans for shutting in production from the subsea wells are addressed as part of the emergency curtailment plan. The plan specifies the various alerts and shutdown criteria linked to both weather and facility performance data, with the intent to have operations suspended and the wells secured in the event of a hurricane or emergency situation. Ensuring adequate time to safely and efficiently suspend operations and secure the well is a key component of the planning effort. Clearly defined responsibilities for the facility personnel are part of the successful implementation of the emergency response effort.

For a severe weather event such as a hurricane, emergency curtailment plans would address the criteria and structured procedures for suspending operations and ultimately securing the wellbore(s) prior to weather conditions that could exceed the design operating limitations of the drilling or production unit. For drilling operations, the plan might also address procedures for disconnecting and moving the drilling unit off location after the well has been secured, should the environmental conditions exceed the floating drilling unit's capability to maintain station. Curtailment of operations consists of various stages of "alerts" indicating the deterioration of meteorological, oceanographic, or wellbore conditions. Higher alert levels require increased monitoring, the curtailment of lengthy wellbore operations, and, if conditions warrant, the eventual securing of the well. If conditions improve, operations could resume based on the limitations established in the contingency plan for the known environmental conditions. The same emergency curtailment plans would be implemented in an anticipated or impending emergency situation, such as the threat of a terrorist attack.

Neither BOEMRE nor USCG mandates that an operator must evacuate a production facility for a hurricane; it is a decision that rests solely with the operator. The USCG does require the submittal of an emergency evacuation plan that addresses the operator's intentions for evacuation of nonessential personnel, egress routes on the production facility, lifesaving and personnel safety devices, firefighting equipment, etc. As activities move farther from shore, it may become safer to not evacuate the facility because helicopter operations become inherently more risky with greater flight times. Severe weather conditions also increase the risks associated with helicopter operations. The precedent for leaving a facility manned during severe weather is established in the North Sea and other operating basins.

Redundant, fail-safe, automatic shut-in systems located inside the wellbore and at the sea surface, and in some instances at the seafloor, are designed to prevent or minimize pollution. These systems are designed and tested to ensure proper operation should a production facility or well be catastrophically damaged. Testing occurs at regular intervals with predetermined performance limits designed to ensure functioning of the systems in case of an emergency. After the DWH event, the testing requirements for well control systems came under immediate scrutiny in the DOI Secretary's "Safety Measures Report" that was delivered to him on May 27, 2010. The Safety Measures Report included a recommendation of a program for the immediate recertification of BOP's. As stated above, the new regulatory section at

30 CFR 250.451(i) requires that, if a blind-shear ram or casing shear ram is activated in a well control situation where the pipe is sheared, the BOP stack must be retrieved, fully inspected, and tested (*Federal Register*, 2010b). This and other new regulations that improve safety in the event of an emergency are described above in **Chapter 1.3.1**.

Permits and Applications

After EP or DOCD approval, the operator submits applications for specific activities to BOEMRE for approval. These applications include those for drilling wells; well-test flaring; temporary well abandonment; installing a well protection structure, production platforms, satellite structures, subsea wellheads and manifolds, and pipelines; installation of production facilities; commencing production operations; platform removal and lease abandonment; and pipeline decommissioning.

Wells

The BOEMRE requirements for the drilling of wells can be found at 30 CFR 250 Subpart D. Lessees are required to take precautions to keep all wells under control at all times. The lessee must use the best available and safest technology to enhance the evaluation of abnormal pressure conditions and to minimize the potential for uncontrolled well flow.

Prior to conducting drilling operations, the operator is required to submit and obtain approval for an APD. The APD requires detailed information—including project layout at a scale of 24,000:1, design criteria for well control and casing, specifications for blowout preventers, a mud program, cementing program, directional drilling plans, etc.—to allow for BOEMRE's evaluation of operational safety and pollution-prevention measures. The APD is reviewed for conformance with the engineering requirements and other technical considerations.

The BOEMRE is responsible for conducting technical and safety reviews of all drilling, workover, and production operations on the OCS. These detailed analyses determine if the lessee's proposed operation is in compliance with all regulations and all current health, safety, environmental, and classical engineering standards.

The BOEMRE regulations at 30 CFR 250.1710-1717 address the requirements for permanent abandonment of a well on the OCS. A permanent abandonment includes the isolation of zones in the open wellbore, plugging of perforated intervals, plugging the annular space between casings (if they are open), setting a surface plug, and cutting and retrieving the casing at least 15 ft (5 m) below the mudline. All plugs must be tested in accordance with the regulations. There are no routine surveys of permanently abandoned well locations. If a well were found to be leaking, BOEMRE would require the operator of record to perform an intervention to repair the abandonment. If a well is temporarily abandoned at the seafloor, an operator must provide BOEMRE with an annual report summarizing plans to permanently abandon the well or to bring the well into production.

Platforms and Structures

The BOEMRE does a technical review of all proposed structure designs and installation procedures. All proposed facilities are reviewed for structural integrity. These detailed engineering reviews entail an evaluation of all operator proposals for fabrication, installation, modification, and repair of all mobile and fixed structures. The lessee must design, fabricate, install, use, inspect, and maintain all platforms and structures on the OCS to assure their structural integrity for the safe conduct of operations at specific locations. Applications for platform and structure approval are filed in accordance with 30 CFR 250.901. Design requirements are presented in detail at 30 CFR 250.904 through 250.909. The lessee evaluates characteristic environmental conditions associated with operational functions to be performed. Factors such as waves, wind, currents, tides, temperature, and the potential for marine growth on the structure are considered. In addition, pursuant to 30 CFR 250.902 and 250.903, a program has been established by BOEMRE to assure that new structures meeting the conditions listed under 30 CFR 250.900(c) are designed, fabricated, and installed using standardized procedures to prevent structural failures. This program facilitates review of such structures and uses third-party expertise and technical input in the verification process through the use of a Certified Verification Agent. After installation, platforms and structures are required to be periodically inspected and maintained under 30 CFR 250.912.

Pipelines

Regulatory processes and jurisdictional authority concerning pipelines on the OCS and in coastal areas are shared by several Federal agencies, including DOI, Department of Transportation (DOT), U.S. Army Corps of Engineers (COE), the Federal Energy Regulatory Commission, and the USCG. Aside from pipeline regulations, these agencies have the responsibility of overseeing and regulating the following areas: the placement of structures on the OCS and pipelines in areas that affect navigation; the certification of proposed projects involving the transportation or sale of interstate natural gas, including OCS gas; and the right of eminent domain exercised by pipeline companies onshore. In addition, DOT is responsible for promulgating and enforcing safety regulations for the transportation in interstate commerce of natural gas, liquefied natural gas (LNG), and hazardous liquids by pipeline. This includes, for the most part, offshore pipelines on State lands beneath navigable waters and on the OCS that are operated by transmission companies. The regulations are contained in 49 CFR 191 through 193 and 195. In a Memorandum of Understanding (MOU) between DOT and DOI dated December 10, 1996, each party's respective regulatory responsibilities are outlined. The DOT is responsible for establishing and enforcing design, construction, operation, and maintenance regulations, and for investigating accidents for all OCS transportation pipelines beginning downstream of the point at which operating responsibility transfers from a producing operator to a transporting operator. The DOI's responsibility extends upstream from the transfer point described above.

The BOEMRE is responsible for regulatory oversight of the design, installation, and maintenance of OCS producer-operated oil and gas pipelines. The BOEMRE operating regulations for pipelines found at 30 CFR 250 Subpart J are intended to provide safe and pollution-free transportation of fluids in a manner that does not unduly interfere with other users of the OCS. Pipeline applications are usually submitted and reviewed separately from DOCD's. Pipeline applications may be for on-lease pipelines or rights-of-way for pipelines that cross other lessees' leases or unleased areas of the OCS. Pipeline permit applications to BOEMRE include the pipeline location drawing, profile drawing, safety schematic drawing, pipe design data, a shallow hazard survey report, and an archaeological report, if applicable.

The BOEMRE evaluates the design, fabrication, installation, and maintenance of all OCS pipelines. Proposed pipeline routes are evaluated for potential seafloor or subsea geologic hazards and other natural or manmade seafloor or subsurface features or conditions (including other pipelines) that could have an adverse impact on the pipeline or that could be adversely impacted by the proposed operations. Routes are also evaluated for potential impacts on archaeological resources and biological communities. A NEPA review is conducted in accordance with applicable policies and guidelines. The BOEMRE prepares an EA on all pipeline rights-of-way that go ashore. For Federal consistency, applicants must comply with the regulations as clarified in NTL 2007-G20, "Coastal Zone Management Program Requirements for OCS Right-of-way Pipeline Applications." All Gulf States require consistency review of right-of-way pipeline applications as described in the clarifying NTL.

The design of the proposed pipeline is evaluated for an appropriate cathodic protection system to protect the pipeline from leaks resulting from the effects of external corrosion of the pipe; an external pipeline coating system to prolong the service life of the pipeline; measures to protect the inside of the pipeline from the detrimental effects, if any, of the fluids being transported; the submersibility of the line (i.e., that the pipeline will remain in place on the seafloor and not have the potential to float, even if empty or filled with gas rather than liquids); proposed operating pressure of the line; and protection of other pipelines crossing the proposed route. Such an evaluation includes the following: (1) reviewing the calculations used by the applicant in order to determine whether the applicant properly considered such elements as the grade of pipe to be used, the wall thickness of the pipe, derating factors (the practice of operating a component well inside its normal operating limits to reduce the rate at which the component deteriorates), related to the submerged and riser portions of the pipeline, the pressure rating of any valves or flanges to be installed in the pipeline, the pressure rating of any other pipeline(s) into which the proposed line might be tied, and the required pressure to which the line must be tested before it is placed in service; (2) protective safety devices such as pressure sensors and remotely operated valves, the physical arrangement of those devices proposed to be installed by the applicant for the purposes of protecting the pipeline from possible overpressure conditions and for detecting and initiating a response to abnormally low-pressure conditions; and (3) the applicant's planned compliance with regulations requiring that pipelines installed in water depths less than 200 ft (61 m) be buried to a depth of at least 3 ft

(1 m) (30 CFR 250.1003). In addition, pipelines crossing fairways require a COE permit and must be buried to a depth of at least 10 ft (3 m) and to 16 ft (5 m) if crossing an anchorage area.

Operators are required to periodically inspect pipeline routes. Monthly overflights are conducted to inspect pipeline routes for leakage.

Applications for pipeline decommissioning must also be submitted for BOEMRE review and approval. Decommissioning applications are evaluated to ensure they will render the pipeline inert and/or to minimize the potential for the pipeline becoming a source of pollution by flushing and plugging the ends and to minimize the likelihood that the decommissioned line will become an obstruction to other users of the OCS by filling it with water and burying the ends.

Inspection and Enforcement

The OCSLA authorizes and requires BOEMRE to provide for both an annual scheduled inspection and a periodic unscheduled (unannounced) inspection of all oil and gas operations on the OCS. The inspections are to assure compliance with all regulatory constraints that allowed commencement of the operation.

The primary objective of an initial inspection is to assure proper installation of mobile drilling units and fixed structures, and proper functionality of their safety and pollution prevention equipment. After operations begin, additional announced and unannounced inspections are conducted. Unannounced inspections are conducted to foster a climate of safe operations, to maintain a BOEMRE presence, and to focus on operators with a poor performance record. These inspections are also conducted after a critical safety feature has previously been found defective. Poor performance generally means that more frequent, unannounced inspections may be conducted on a violator's operation.

The annual inspection examines all safety equipment designed to prevent blowouts, fires, spills, or other major accidents. These annual inspections involve the inspection for installation and performance of all facilities' safety-system components.

The inspectors follow the guidelines as established by the regulations, API RP 14C, and the specific BOEMRE-approved plan. The BOEMRE inspectors perform these inspections using a national checklist called the Potential Incident of Noncompliance (PINC) list. This list is a compilation of yes/no questions derived from all regulated safety and environmental requirements.

The BOEMRE administers an active civil penalties program (30 CFR 250 Subpart N). A civil penalty in the form of substantial monetary fines may be issued against any operator that commits a violation that may constitute a threat of serious, irreparable, or immediate harm or damage to life, property, or the environment. The BOEMRE may make recommendations for criminal penalties if a willful violation occurs. In addition, the regulation at 30 CFR 250.173(a) authorizes suspension of any operation in the GOMR if the lessee has failed to comply with a provision of any applicable law, regulation, or order or provision of a lease or permit. Furthermore, the Secretary may invoke his authority under 30 CFR 250.185(c) to cancel a nonproductive lease with no compensation. Exploration and development activities may be canceled under 30 CFR 250.182 and 250.183.

Pollution Prevention, Oil-Spill Response Plans, and Financial Responsibility

Pollution Prevention

Pollution prevention is addressed through proper design and requirements for safety devices. The BOEMRE regulations at 30 CFR 250.400 require that the operator take all necessary precautions to keep its wells under control at all times. The lessee is required to use the best available and safest drilling technology in order to enhance the evaluation of conditions of abnormal pressure and to minimize the potential for the well to flow or kick. Redundancy is required for critical safety devices that will shut off flow from the well if loss of control is encountered. A complete description of rule changes implemented as a result of the DWH event is detailed in **Chapter 1.3.1**.

In addition, BOEMRE regulations at 30 CFR 250 Subparts E, F, and H require that the lessee assure the safety and protection of the human, marine, and coastal environments during completion, workover, and production operations. All production facilities, including separators, treaters, compressors, headers, and flowlines are required to be designed, installed, tested, maintained, and used in a manner that provides for efficiency, safety of operations, and protection of the environment. Wells, particularly subsea wells, include a number of sensors that help in detecting pressures and the potential for leaks in the production system. Safety devices are monitored and tested frequently to ensure their operation, should an incident occur. To ensure that safety devices are operating properly, BOEMRE incorporates the API RP 14C into the operating regulations. The API RP 14C incorporates the knowledge and experience of the oil and gas industry regarding the analysis, design, installation, and testing of the safety devices used to prevent pollution. The API RP 14C presents proven practices for providing these safety devices for offshore production platforms. Proper application of these practices, along with good design, maintenance, and operation of the entire production facility, should provide an operationally safe and pollution-free production platform.

Also, BOEMRE regulations at 30 CFR 250 Subpart J require that pipelines and associated valves, flanges, and fittings be designed, installed, operated, and maintained to provide safe and pollution-free transportation of fluids in a manner that does not unduly interfere with other uses on the OCS.

The BOEMRE regulation at 30 CFR 250.300(a) requires that lessees not create conditions that will pose an unreasonable risk to public health, life, property, aquatic life, wildlife, recreation, navigation, commercial fishing, or other uses of the ocean during offshore oil and gas operations. The lessee is required to take measures to prevent the unauthorized discharge of pollutants into the offshore waters. Control and removal of pollution is the responsibility and at the expense of the lessee. Immediate corrective action to an unauthorized release is required. All hydrocarbon-handling equipment for testing and production, such as separator and treatment tanks, are required to be designed, installed, and operated to prevent pollution. Maintenance and repairs that are necessary to prevent pollution are required to be taken immediately. Drilling and production facilities are required to be inspected daily or at intervals approved or prescribed by the BOEMRE District Supervisor to determine if pollution is occurring.

Operators are required to install curbs, gutters, drip pans, and drains on platform and rig deck areas in a manner necessary to collect all greases, contaminants, and debris not authorized for discharge. The rules also explicitly prohibit the disposal of equipment, cables, chains, containers, or other materials into offshore waters. Portable equipment, spools or reels, drums, pallets, and other loose items must be marked in a durable manner with the owner's name prior to use or transport over offshore waters. Smaller objects must be stored in a marked container when not in use. Operational discharges such as produced water and drilling muds and cuttings are regulated by USEPA through the National Pollutant Discharge Elimination System (NPDES) permit program. The BOEMRE may restrict the rate of drilling fluid discharge or prescribe alternative discharge methods. No petroleum-based substances, including diesel fuel, may be added to the drilling mud system without prior approval of the BOEMRE District Supervisor.

Blowout Preventers

A blowout preventer (BOP) is a complex of choke lines and hydraulic rams mounted atop the well head that can seal off the casing of a well by remote control at the surface. There are different types of BOP's. A pipe ram closes on the drill pipe by pinching it, but it cannot seal on open hole. A blind ram is a straight-edged rams used to close an open hole. The BOP's were invented in the early-1920's and have been instrumental in ending dangerous, costly, and environmentally damaging oil gushers. The BOP's have been required for OCS oil and gas operations from the time offshore drilling began in the late 1940's. There are two types: ram and annular (also called spherical). Rams were deployed in the 1920's and annular preventers in the 1950's. Rams are designed to seal an open hole by closing the wellbore with a sharp horizontal motion that may cut through casing or tool strings, as a last resort. An annular BOP closes around the drill string in a smooth simultaneous upward and inward motion. Both types are usually used together to create redundancy in a BOP stack. Because BOP's are important for the safety of the drilling crew, as well as the rig and the wellbore itself, BOP's are regularly inspected, tested, and refurbished. The BOP's are actuated as a last resort upon imminent threat to the integrity of the well or the surface rig (**Chapter 3.2.2**). New regulations for BOP's were published on October 14, 2010, as described in **Chapter 1.3.1** (*Federal Register,* 2010b).

Oil-Spill Response Plans

The BOEMRE's responsibilities under the Oil Pollution Act of 1990 (OPA) include spill prevention, review, and approval of oil-spill response plans (OSRP's); inspection of oil-spill containment and cleanup equipment; and ensuring oil-spill financial responsibility for facilities in offshore waters located seaward of the coastline or in any portion of a bay that is connected to the sea either directly or through one or more other bays. The BOEMRE regulations (30 CFR 254) require that all owners and operators of oil-handling, storage, or transportation facilities located seaward of the coastline submit an OSRP for approval. The term "coastline" means the line of ordinary low water along that portion of the coast that is in direct contact with the open sea and the line marking the seaward limit of inland waters. The term "facility" means any structure, group of structures, equipment, or device (other than a vessel), which is used for one or more of the following purposes: exploring for; drilling for; producing; storing; handling; transferring; processing; or transporting oil. A mobile offshore drilling unit (MODU) is classified as a facility when engaged in drilling or downhole operations.

The regulation at 30 CFR 254.2 requires that an OSRP must be submitted and approved before an operator can use a facility. The BOEMRE can grant an exception to this requirement during the BOEMRE review of an operator's submitted OSRP. In order to be granted this exception during this time period, an owner/operator must certify in writing to BOEMRE that it is capable of responding to a "worst-case" spill or the substantial threat of such a spill. To continue operations, the facility must be operated in compliance with the approved OSRP or the BOEMRE-accepted "worst-case" spill certification. Owners or operators of offshore pipelines are required to submit an OSRP for any pipeline that carries oil, condensate, or gas with condensate; pipelines carrying essentially dry gas do not require an OSRP. Current OSRP's are required for abandoned facilities until they are physically removed or dismantled.

The OSRP describes how an operator intends to respond to an oil spill. The OSRP may be site-specific or regional (30 CFR 254.3). The term "regional" means a spill response plan that covers multiple facilities or leases of an owner or operator, including affiliates, which are located in the same BOEMRE GOM region. The subregional plan concept is similar to the regional concept, which allows leases or facilities to be grouped together for the purposes of (1) calculating response times, (2) determining quantities of response equipment, (3) conducting oil-spill trajectory analyses, (4) determining worst-case discharge scenarios, and (5) identifying areas of special economic and environmental importance that may be impacted and the strategies for their protection. The number and location of the leases and facilities allowed to be covered by a subregional OSRP will be decided by BOEMRE on a case-by-case basis considering the proximity of the leases or facilities proposed to be covered. NTL 2006-G21 includes guidance on the preparation and submittal of subregional OSRP's.

The Emergency Response Action Plan within the OSRP serves as the core of the BOEMRE-required OSRP. In accordance with 30 CFR 254, the Emergency Response Action Plan requires identification of (1) the qualified individual and the spill-response management team, (2) the spill-response operating team, (3) the oil-spill cleanup organizations under contract for response, and (4) the Federal, State, and local regulatory agencies that an owner/operator must notify or that they must consult with to obtain site-specific environmental information when an oil spill occurs. The OSRP is also required to include an inventory of appropriate equipment and materials, their availability, and the time needed for deployment, as well as information pertaining to dispersant use, in-situ burning, a worst-case discharge scenario, contractual agreements, training and drills, identification of potentially impacted environmental resources and areas of special economic concern and environmental importance, and strategies for the protection of these resources and areas. The response plan must provide for response to an oil spill from their facility and the operator must immediately carry out the provisions of the plan whenever an oil spill from the facility occurs. The OSRP must be in compliance with the National Contingency Plan and the Area Contingency Plan(s) (ACP). The operator is also required to carry out the training, equipment testing, and periodic drills described in the OSRP. All BOEMRE-approved OSRP's must be reviewed at least every 2 years. In addition, revisions must be submitted to BOEMRE within 15 days whenever

(1) a change occurs that appreciably reduces an owner/operator's response capabilities;

(2) a substantial change occurs in the worst-case discharge scenario or in the type of oil being handled, stored, or transported at the facility;

(3) there is a change in the name(s) or capabilities of the oil-spill removal organizations cited in the OSRP; or

(4) there is a change in the applicable ACP's.

As a result of the DWH event, although BOEMRE is not requiring the submission of revised OSRP's at this time, the Agency will provide guidance regarding additional information that operators should submit regarding spill response and surface containment in light of the "worst case" discharge calculations that are now required by BOEMRE regulations and as clarified in NTL 2010-N06, "Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS," which became effective on June 18, 2010. This NTL provides clarification of the regulations requiring a lessee or operator to submit supplemental information for new or previously submitted EP's, development and production plans (DPP's), or DOCD's. The required supplemental information includes the following: (1) a description of the blowout scenario as required by 30 CFR 250.213(g) and 250.243(h); (2) a description of their assumptions and calculations used in determining the volume of the worst-case discharge required by 30 CFR 250.219(a)(2)(iv) (for EP's) or 30 CFR 250.250(a)(2)(iv) (for DPP's and DOCD's); and (3) a description of the measures proposed that would enhance the ability to prevent a blowout, to reduce the likelihood of a blowout, and to conduct effective and early intervention in the event of a blowout, including the arrangements for drilling relief wells and any other measures proposed. The early intervention methods could actually include the surface and subsea containment resources that BOEMRE announced in NTL 2010-N10, which states that BOEMRE will begin reviewing to ensure that the measures are adequate to promptly respond to a blowout or other loss of well control.

Additionally, to address new improved containment systems, NTL 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources," became effective on November 8, 2010. This NTL applies only to operators conducting operations using subsea or surface BOP's on floating facilities. It clarifies the regulations that lessees and operators must submit a certification statement signed by an authorized company official with each application for a well permit, indicating that they will conduct all of their authorized activities in compliance with all applicable regulations, including the Increased Safety Measures Regulations at 75 FR 63346. The NTL also informs lessees that BOEMRE will be evaluating whether or not each operator has submitted adequate information demonstrating that it has access to and can deploy surface and subsea containment resources that would be adequate to promptly respond to a blowout or other loss of well control. Although the NTL does not provide that operators submit revised OSRP's that include this containment information at this time, operators were notified of BOEMRE's intention to evaluate the adequacy of each operator to comply in the operator's current OSRP; therefore, there is an incentive for voluntary compliance.

Financial Responsibility

As required by 30 CFR 253.11, a designated applicant must demonstrate oil-spill financial responsibility (OSFR) for covered offshore facilities (COF's). A designated applicant may be a responsible party or another person authorized under 30 CFR 253. These regulations implement the OSFR requirements of Title I of OPA, as amended. Penalties for noncompliance with these requirements are covered at 30 CFR 250.51 and in NTL 2008-N05, "Guidelines for Oil Spill Financial Responsibility for Covered Facilities." A COF, as defined in 30 CFR 253.3, is any structure and all of its components (including wells completed at the structure and the associated pipelines), equipment, pipeline, or device (other than a vessel or other than a pipeline or deepwater port licensed under the Deepwater Port Act of 1974) used for exploring, drilling, or producing oil, or for transporting oil from such facilities. The BOEMRE ensures that each responsible party has sufficient funds for removal costs and damages resulting from the accidental release of liquid hydrocarbons into the environment for which the responsible party is liable.

Air Emissions

The OCSLA (43 U.S.C. 1334(a)(8)) requires the Secretary of the Interior to promulgate and administer regulations that comply with the National Ambient Air Quality Standards (NAAQS), pursuant to the Clean Air Act (CAA) (42 U.S.C. 7401 et seq.), to the extent that authorized activities significantly affect the air quality of any State. Under provisions of the CAA Amendments (CAAA) of 1990, the USEPA Administrator has jurisdiction and, in consultation with the Secretary of the Interior and the Commandant of the Coast Guard, established the requirements to control air pollution in OCS areas of the

Pacific, Atlantic, Arctic, and eastward of 87.5° W. longitude in the GOM. Air quality in the OCS area westward of 87.5° W. longitude in the Gulf is under BOEMRE jurisdiction.

For OCS air emission sources located east of 87.5° W. longitude and within 25 mi (40 km) of the States' seaward boundaries, the requirements are the same as would be applicable if the source were located in the corresponding onshore area. The USEPA requirements for these OCS areas are at 40 CFR 55, Appendix A. For air emission sources located east of 87.5° W. longitude and more than 25 mi (40 km) from the States' seaward boundaries, sources are subject to Federal requirements for Prevention of Significant Deterioration (PSD). The USEPA regulations also establish procedures that allow the USEPA Administrator to exempt any OCS source from an emissions control requirement if it is technically infeasible or poses unreasonable threat to health or safety.

This Agency issued NTL 2009-N11 to clarify that its regulatory authority and the implementing regulations in 30 CFR 250 Subpart C apply only to those air emission sources in the Gulf of Mexico westward of 87.5º W. longitude. The regulated pollutants include carbon monoxide, suspended particulates, sulphur dioxide, nitrogen oxides, total hydrocarbons, and volatile organic compounds. All new or supplemental EP's and DOCD's must include air emissions information sufficient to determine if an air quality review is required (30 CFR 250.218 and 250.49). The BOEMRE regulations require a review of air quality emissions to determine if the projected emissions from a facility result in onshore ambient air concentrations above BOEMRE significance levels and to identify appropriate emissions controls to mitigate potential onshore air quality degradation.

Emissions data for new or modified onshore facilities directly associated with proposed OCS activities are required to be included in development plans submitted to BOEMRE so that affected States can determine potential air quality impacts on their air quality.

The BOEMRE uses a two-level hierarchy of evaluation criteria to evaluate potential impacts of offshore emission sources to onshore areas. The evaluation criteria are the exemption level and the significance level. If the proposed activities exceed the criteria at the first (exemption) level, the evaluation moves to the significance level criteria. The initial evaluation compares the worst-case emissions to the BOEMRE exemption criteria. This corresponds to the USEPA screening step, where the proposed activity emissions are checked against the screening thresholds or "exemption levels." If the proposed activity emissions are below the exemption levels, the proposed action is exempt from further air quality review.

If exemption levels are exceeded, then the second step requires refined modeling using the Offshore and Coastal Dispersion (OCD) Model. The results from the OCD Model, the modeled potential onshore impacts, are compared with BOEMRE significance levels. If the significance levels are exceeded in an attainment area, an area that meets the NAAQS, the operator would be required to apply best available control technology to the emissions source. If the affected area is classified as nonattainment, further emission reductions or offsets may be required. Projected contributions to onshore pollutant concentrations are also subject to the same limits as USEPA applies to the onshore areas under their PSD program.

Flaring/Venting

Flaring is the controlled burning of natural gas, and venting is releasing gas directly into the atmosphere without burning. Flaring/venting may be necessary to remove potentially damaging completion fluids from the wellbore and to provide sufficient reservoir data for the operator to evaluate reservoir development options during unloading/testing operations and/or in emergency situations. The BOEMRE regulates flaring/venting to minimize the loss of revenue producing natural gas resources. The BOEMRE regulations (30 CFR 250) allow, without prior BOEMRE approval, flaring or venting of natural gas on a limited basis under certain specified conditions. Regulations permit more extensive flaring/venting with prior approval from BOEMRE. Records must always be prepared by the operator for all flaring/venting, and justification must be provided for flaring/venting not expressly authorized by BOEMRE regulations.

Hydrogen Sulfide Contingency Plans

The operator of a lease must request a BOEMRE area classification for the presence of hydrogen sulfide (H_2S) gas. The BOEMRE classifies areas for proposed operations as (1) H_2S absent, (2) H_2S present, or (3) H_2S unknown.

All OCS operators concerned with the production of sour (contains H_2S) hydrocarbons that could result in atmospheric H_2S concentrations above 20 parts per million are required to file an H_2S contingency plan with BOEMRE. This plan must include the 30 CFR 250 requirements that are intended to ensure workers safety at the production facility and provide contingencies for; simultaneous drilling, well-completion, well-workovers, and production operations. The NTL 2009-G31, "Hydrogen Sulfide (H_2S) Requirements," provides clarification, guidance, and information regarding BOEMRE's H_2S regulations at 30 CFR 250.

Archaeological Resources Regulation

Bottom-disturbing operations such as well placement, anchoring, and pipelaying activities can lead to damage to any resources that reside on the seabed, including archaeological resources such as historic shipwrecks. The archaeological resources regulation at 30 CFR 250.194 grants authority in certain cases to each BOEMRE Regional Director to require that archaeological reports be submitted with the EP, DOCD, or DPP where deemed necessary. The technical requirements of the archaeological resource reports are detailed in NTL 2005-G07, "Archaeological Resource Surveys and Reports." If the evidence from the operator's geophysical survey and/or archaeological report suggests that an archaeological resource may be present, the lessee must either locate the site of any operation so as not to adversely affect the area where the archaeological resource may be, demonstrate that an archaeological resource does not exist, or demonstrate that archaeological resources will not be adversely affected by operations. If the lessee discovers any archaeological resource while conducting approved operations, operations must be immediately stopped and the discovery reported to the BOEMRE Regional Supervisor, Office of Leasing and Environment, within 48 hours of its discovery.

High-resolution surveys, where required, provide an effective tool that analysts use to identify and help protect archaeological resources; however, such survey coverage is often not available for all areas of the Gulf of Mexico, particularly in deeper water where oil and gas activities are increasing and where more shipwrecks are being identified. As part of the environmental reviews conducted for postlease activities, available information will be evaluated regarding the potential presence of archaeological resources within the proposed action area to determine if mitigation is warranted.

Coastal Zone Management Consistency Review and Appeals for Plans

The Coastal Zone Management Act (CZMA) places requirements on any applicant for an OCS plan that describes in detail Federal license or permit activities affecting any coastal use or resource, in or outside of a State's coastal zone. The applicant must provide in the OCS plan submitted to BOEMRE a certification and necessary data and information for the State to determine that the proposed activities comply with the enforceable policies of the States' approved coastal management program, and that such activities will be consistent to the maximum extent practicable (16 U.S.C. 1456(c)(3)(A) and 15 CFR 930.76).

Except as provided in 15 CFR 930.60(a), State agency review of the consistency certification begins when the State receives the certification and information required pursuant to 15 CFR 930.76(a) and (b). Only missing information can be used to delay the commencement of State agency review, and a request for information and data that are not required by 15 CFR 930.76 will not extend the date of commencement of review (15 CFR 930.58). Under the CZMA, each State with an approved CMP may require information that is different from that specifically outlined in these regulations. All of the Gulf States have approved CMP's. Requirements for the CZM consistency information for Texas and Louisiana are found at 30 CFR 250.226 and 250.260, and are given in NTL's 2006-G21, "Regional and Subregional Oil Spill Response Plans"; 2007-G20, "Coastal Zone Management Program Requirements for OCS Right-of-way Pipeline Applications;" 2008-G04, "Information Requirements for Exploration Plans and Development Operations Coordination Documents"; and 2009-G27, "Submitting Exploration Plans and Development Coordination Documents." In accordance with the requirements of 15 CFR

930.76, the BOEMRE's Gulf of Mexico OCS Region sends copies of an OCS plan, including the consistency certification and other data and necessary information, to the designated State CMP agency by receipted mail or other approved communication. If no State-agency objection is submitted by the end of the consistency review period, BOEMRE shall presume consistency concurrence by the State (15 CFR 930.78(b)). The BOEMRE can require modification of a plan if the operator has agreed to certain requirements requested by the State.

If the BOEMRE receives a written consistency objection from the State, the BOEMRE will not approve any activity described in the OCS plan unless (1) the operator amends the OCS plan to accommodate the objection, concurrence is subsequently received or conclusively presumed; (2) upon appeal, the Secretary of Commerce, in accordance with 15 CFR 930 Subpart H, finds that the OCS plan is consistent with the objectives or purposes of the CZMA or is necessary in the interest of national security; or (3) the original objection is declared invalid by the courts.

Best Available and Safest Technologies

To assure that oil and gas exploration, development, and production activities on the OCS are conducted in a safe and pollution-free manner, 43 U.S.C. 1347(b) of the OCSLA, as amended, requires that all OCS technologies and operations use the best available and safest technology (BAST) whenever practical. The Director may require additional BAST measures to protect safety, health, and the environment, if it is economically feasible and the benefits outweigh the costs. Conformance to the standards, codes, and practices referenced in or required under the authority of 30 CFR 250 is considered the application of BAST. These standards, codes, and practices include requirements for state-of-the-art drilling technology, production safety systems, oil and gas well completions, oil-spill response plans, pollution-control equipment, and specifications for platform/structure designs. The BOEMRE conducts periodic offshore inspections, and continuously and systematically reviews OCS technologies to ensure that the best available and safest technologies are applied to OCS operations. The BAST is not required when BOEMRE determines that the incremental benefits are clearly insufficient to justify increased costs; however, it is the responsibility of an operator of an existing operation to demonstrate why application of a new technology would not be feasible. The BAST requirement is applicable to equipment and procedures that, if failed, would have a significant effect on safety, health, or the environment, unless benefits clearly do not justify the cost (30 CFR 250.107(c) and (d)).

The BAST concept is addressed in the BOEMRE, Gulf of Mexico OCS Region by a continuous effort to locate and evaluate the latest technologies and to report on these advances at periodic Regional Operations Technology Assessment Committee (ROTAC) meetings. A part of the BOEMRE staff has an ongoing function to evaluate various vendors and industry representatives' innovations and improvements in techniques, tools, equipment, procedures, and technologies applicable to oil and gas operations (drilling, producing, completion, and workover operations). This information is provided to BOEMRE district personnel at ROTAC meetings. The requirement for the use of BAST has been, for the most part, an evolutionary process whereby advances in equipment, technologies, and procedures have been integrated into OCS operations over a period of time. Awareness by both BOEMRE inspectors and the OCS operators of the most advanced equipment and technologies has resulted in the incorporation of these advances into day-to-day operations. An example of such an equipment change that evolved over a period of time would be the upgrading of diverter systems on drilling rigs from the smaller diameter systems of the past to the large-diameter, high-capacity systems found on drilling rigs operating on the OCS today.

Production Facilities

The BOEMRE's regulations governing oil and gas production safety systems are found in 30 CFR 250 Subpart H. Production safety equipment used on the OCS must be designed, installed, used, maintained, and tested in a manner to assure the safety and protection of the human, marine, and coastal environments. All tubing installations open to hydrocarbon-bearing zones below the surface must be equipped with safety devices that will shut off the flow from the well in the event of an emergency, unless the well is incapable of flowing. Surface- and subsurface-controlled safety valves and locks must conform to the requirements of 30 CFR 250.801. All surface production facilities, including separator and treatment tanks, compressors, headers, and flowlines must be designed, installed, and maintained in a manner that provides for efficiency, safety of operations, and protection of the environment. Production facilities also have stringent requirements concerning electrical systems, flowlines, engines, and firefighting systems. The safety-system devices are tested by the lessee at specified intervals and must be in accordance with API RP 14 C Appendix D and other measures.

Personnel Training and Education

An important factor in ensuring that offshore oil and gas operations are carried out in a manner that emphasizes operational safety and minimizes the risk of environmental damage is the proper training of personnel. Under 30 CFR 250.1500 Subpart O, BOEMRE has outlined well control and production safety training program requirements for lessees operating on the OCS. The goal of the regulation (30 CFR 250.1501) is safe and clean OCS operations. Lessees must ensure that their employees and contract personnel engaged in well control or production safety operations understand and can properly perform their duties. To accomplish this, the lessee must establish and implement a training program so that all of their employees are trained to competently perform their assigned well control and production safety duties. The lessee must also verify that their employees understand and can perform the assigned duties.

The mandatory Drilling Well-Control Training Program was instituted by this Agency in 1979. In 1983, the mandatory Safety Device Training Program was established to ensure that personnel involved in installing, inspecting, testing, and maintaining safety devices are qualified. As a preventive measure, all offshore personnel must be trained to operate oil-spill cleanup equipment, or the lessee must retain a trained contractor(s) to operate the equipment for them. In addition, BOEMRE offers numerous technical seminars to ensure that personnel are capable of performing their duties and are incorporating the most up-to-date safety procedures and technology in the petroleum industry. In 1994, the Office of Safety Management created this Agency's Offshore Training Institute to develop and implement an inspector training program. The Institute introduced state-of-the-art multimedia training to the inspector work force and has produced a series of interactive computer training modules.

Structure Removal and Site Clearance

During exploration, development, and production operations, temporary and permanent equipment and structures are often required to be embedded into or placed onto the seafloor around activity areas. In compliance with Section 22 of BOEMRE's Oil and Gas Lease Form (MMS-2005) and OCSLA regulations (30 CFR 250.1710—*Wellheads/Casings* and 30 CFR 250.1725—*Platforms and Other Facilities*), operators need to remove seafloor obstructions from their leases within 1 year of lease termination or after a structure has been deemed obsolete or unusable. These regulations also require the operator to sever bottom-founded objects and their related components at least 5 m (15 ft) below the mudline (30 CFR 250.1716(a)—*Wellheads/Casings* and 30 CFR 250.1728(a)—*Platforms and Other Facilities*). The severance operations are generally categorized as explosive or nonexplosive.

Chapter 1.5 of the Multisale EIS describes regulations, reporting guidelines, and specific mitigation measures developed through consultation, pursuant to Section 7 of the ESA and the MMPA, concerning potential impacts on endangered and threatened species associated with explosive severance activities conducted during the structure-removal operations. All of the current terms and conditions of structure and well removal activities are outlined in NTL 2010-G05, "Decommissioning Guidance for Wells and Platforms," which became effective on October 15, 2010.

Marine Protected Species NTL's

Three NTL's that were issued in 2007 advise operators of measures designed to reduce impacts to Marine Protected Species: NTL 2007-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program"; NTL 2007-G03, "Marine Trash and Debris Awareness and Elimination"; and NTL 2007-G04, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting." The provisions outlined in these NTL's apply to all existing and future oil and gas operations in the Gulf of Mexico OCS.

The NTL 2007-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," provides guidance to protect marine mammals and sea turtles during seismic operations. This NTL clarifies how operators should implement seismic survey mitigation measures, including ramp-up procedures, the use of a minimum sound source, airgun testing, and protected species observation and reporting. The measures contained in this NTL apply to all on-lease surveys conducted under 30 CFR 250 and to all off-lease surveys conducted under 30 CFR 251.

The NTL 2007-G03, “Marine Trash and Debris Awareness and Elimination,” provides guidance to prevent intentional and/or accidental introduction of debris into the marine environment. Operators are prohibited from deliberately discharging containers and other similar materials (i.e., trash and debris) into the marine environment (30 CFR 250.300(a) and (b)(6)) and are required to make durable identification markings on equipment, tools, containers (especially drums), and other material (30 CFR 250.300(c)). The intentional jettisoning of trash has been the subject of strict laws such as the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V and the Marine Plastic Pollution Research and Control Act, and regulations imposed by various agencies including USCG and USEPA. These USCG and USEPA regulations require that operators become more proactive in avoiding accidental loss of solid-waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. The NTL 2007-G03 states marine debris placards must be posted in prominent places on all fixed and floating production facilities that have sleeping or food preparation capabilities and on mobile drilling units. Operators must also ensure that all of their offshore employees and those contractors actively engaged in their offshore operations complete annual training that includes (1) viewing a training video or slide show (specific options are outlined in the NTL) and (2) receiving an explanation from the lessee company’s management that emphasizes their commitment to the NTL’s provisions. An annual report that describes the marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year is to be provided to BOEMRE by January 31 of each year.

The NTL 2007-G04, “Vessel Strike Avoidance and Injured/Dead Protected Species Reporting,” explains how operators must implement measures to minimize the risk of vessel strikes to protected species and report observations of injured or dead protected species. Vessel operators and crews must maintain a vigilant watch for marine protected species and slow down or stop their vessel to avoid striking protected species. Crews must report sightings of any injured or dead protected species (marine mammals and sea turtles) immediately, regardless of whether the injury or death is caused by their vessel, to the Marine Mammal and Sea Turtle Stranding Hotline or the Marine Mammal Stranding Network. In addition, if it was the operator’s vessel that collided with a protected species, BOEMRE must be notified within 24 hours of the strike.

Rigs-to-Reefs

Rigs-to-Reefs (RTR) is a term for converting obsolete, nonproductive offshore oil and gas platforms to designated artificial reefs (Dauterive, 2000). Disposal of obsolete offshore oil and gas platforms is not only a financial liability for the oil and gas industry but it can be a loss of productive marine habitat. The use of obsolete oil and gas platforms for reefs has proven to be highly successful. Their availability, design profile, durability, and stability provide a number of advantages over the use of traditional artificial reef materials. To capture this valuable fish habitat, the States of Louisiana, Texas, and Mississippi, in 1986, 1989, and 1999, respectively, passed enabling legislation and signed into law a RTR program to coincide with their respective States’ Artificial Reef Plan. Alabama and Florida have no RTR legislation. The State laws set up a mechanism to transfer ownership and liability of the platform from oil and gas companies to the State when the platform ceases production and the lease is terminated. The company (donor) saves money by donating a platform to the State (recipient) for a reef rather than scrapping the platform onshore. The industry then donates 50 percent of the savings to the State, which is put toward the State’s artificial reef program. Since the inception of the RTR program, more than 300 retired platforms have been donated and used as reefs in the GOM.

1.6. Other OCS-Related Activities

The BOEMRE has programs and activities that are OCS related but not specific to the oil and gas leasing process or to the management of exploration, development, and production activities. These programs include both environmental and technical studies, and cooperative agreements with other Federal and State agencies for NEPA work, joint jurisdiction over cooperative efforts, inspection activities, and regulatory enforcement. The BOEMRE also participates in industry research efforts and forums.

Environmental Studies Program

The Environmental Studies Program (ESP) was established in 1973 in accordance with Section 20 of the OCSLA. The goals of the ESP are to obtain environmental and socioeconomic information that can be used to assess the potential and real effects of the GOM OCS natural gas and oil program. As a part of the ESP, the Gulf of Mexico OCS Region has funded more than 350 completed or ongoing environmental studies. The types of studies funded include

- literature reviews and baseline studies of the physical, chemical, and biological environment of the shelf;
- literature review and studies of the physical, chemical, and biological environment of deep water (>300 m or 1,000 ft);
- studies of the socioeconomic impacts along the Gulf Coast; and
- studies of the effects of oil and gas activities on the marine environment.

A list of the Gulf of Mexico OCS Region's studies published from 2006 to the present is presented in **Appendix D**. Studies completed since 1974 are available on the BOEMRE, Gulf of Mexico OCS Region's Internet website under "Environmental Program." The BOEMRE's Environmental Studies Program Information System (ESPIS) provides immediate access to all completed BOEMRE studies. The ESPIS is a searchable, web-based, full-text retrieval system allowing users to view online or to download the complete text of any completed ESP report. A complete list of all ongoing Gulf of Mexico OCS Region studies is available on the BOEMRE Internet website. Each listing not only describes the research being conducted but also shows the institution performing the work, the cost of the effort, timeframe, and any associated publications, presentations, or affiliated websites.

The ESP funds studies to obtain information needed for NEPA assessment and the management of environmental and socioeconomic impacts on the human, marine, and coastal environments that may be affected by OCS oil and gas development. The ESP studies were used by BOEMRE's Gulf of Mexico OCS Region analysts to prepare this document. While not all of the Gulf of Mexico OCS Region's studies are specifically referenced in this document, they were used by analysts as input into their analyses. The information in ESP studies is also used by decisionmakers to manage and regulate exploration, development, and production activities on the OCS.

Technology Assessment & Research Program

The Technology Assessment & Research (TA&R) Program supports research associated with operational safety and pollution prevention as well as oil-spill response and cleanup capabilities. The TA&R Program is comprised of two functional research activities: (1) operational safety and engineering research (topics such as air quality, decommissioning, and mooring and anchoring); and (2) oil-spill research (topics such as behavior of oil, chemical treating agents, and in situ burning of oil). The TA&R Program has four primary objectives.

- Technical Support—Providing engineering support in evaluating industry operational proposals and related technical issues and in ensuring that these proposals comply with applicable regulations, rules, and operational guidelines and standards.
- Technology Assessment—Investigating and assessing industry applications of technological innovations and ensuring that governing BOEMRE regulations, rules, and operational guidelines ensure the use of BAST (**Chapter 1.5**, *New and Unusual Technology*).

- Research Catalyst—Promoting and participating in industry research initiatives in the fields of operational safety, engineering research, and oil-spill response and cleanup research.
- International Regulations—Supporting international cooperative efforts for research and development initiatives to enhance the safety of offshore oil and natural gas activities and the development of appropriate regulatory program elements worldwide.

Interagency Agreements

Memoranda of Understanding under NEPA

Section 1500.5(b) of the CEQ implementing regulations (40 CFR 1500.5(b)) encourages agency cooperation early in the NEPA process. A Federal agency can be a lead, joint lead, or cooperating agency. A lead agency manages the NEPA process and is responsible for the preparation of an EIS; a joint lead Agency shares these responsibilities; and a cooperating agency that has jurisdiction by law and has special expertise with respect to any environmental issue shall participate in the NEPA process upon the request of the lead agency.

When an agency becomes a Cooperating Agency, the cooperating and lead agencies usually enter into an MOU, previously called a Cooperating Agency Agreement. The Agreement details the responsibilities of each participating agency. The BOEMRE, as lead agency, has requested other Federal agencies to become cooperating agencies while other agencies have requested BOEMRE to become a cooperating agency (e.g., the Ocean Express Pipeline project). Some projects, such as major gas pipelines across Federal waters and projects under the Deepwater Port Act of 1974, can require cooperative efforts by multiple Federal and State agencies.

The NOI included an invitation to other Federal agencies and State, tribal, and local governments to consider becoming cooperating agencies in the preparation of this Supplemental EIS. Consultation and coordination activities for this Supplemental EIS are described in **Chapter 5**.

Memorandum of Understanding and Memoranda of Agreement between MMS (BOEMRE) and USCG

Since BOEMRE and USCG have closely related jurisdiction over different aspects of safety and operations on the OCS, the agencies have established a formal MOU that delineates lead responsibilities for managing OCS activities in accordance with the OCSLA, as amended, and OPA. The latest MOU, dated September 30, 2004, supersedes the August 1989 and December 1998 versions of the interagency agreement. The MOU is designed to minimize duplication and promote consistent regulation of facilities under the jurisdiction of both agencies. A Memorandum of Agreement (MOA), OCS No. 1—Agency Responsibilities, between BOEMRE and USCG, dated September 30, 2004, further clarifies the technical and process section of the BOEMRE/USCG MOU. The MOA requires the participating agencies to review their internal procedures and, where appropriate, revise them to accommodate the provisions of the September 2004 MOA. To facilitate coordination with USCG, BOEMRE has established a full-time position within the Office of Offshore Regulatory Programs to provide liaison between the agencies.

Generally, the MOU identifies BOEMRE as the lead agency for matters concerning the equipment and operations directly involved in the production of oil and gas. These include, among others, design and operation of risers, permanent mooring foundations of the facility, drilling and well production and services, inspection and testing of all drilling-related equipment, and platform decommissioning. Issues regarding certain aspects of safe operation of the facility, its systems, and equipment generally fall under the jurisdiction of USCG. These include, among others, design of vessels, their sea-keeping characteristics, propulsion and dynamic positioning systems, supply and lightering procedures and equipment, utility systems, safety equipment and procedures, and pollution prevention and response procedures. In 2002, this Agency was authorized to inspect USCG-related safety items on fixed facilities on the OCS.

Generally, the MOA identifies agency responsibilities (i.e., agency representatives for the purpose of keeping each other informed of issues, relevant applications, routine policy determinations and to coordinate joint activities), civil penalties (i.e., USCG refers civil penalty cases to BOEMRE), OSFR (i.e., BOEMRE determines and provides OSFR-related information to USCG upon request), oil-spill preparedness and response planning (i.e., BOEMRE requires responsible parties to maintain approved oil-spill-response plans consistent with Area Contingency Plans and the National Contingency Plan), oil-spill response (i.e., reporting all spills to the National Response Center and direct measures to abate sources of pollution from an OCS facility), accident investigations (i.e., BOEMRE and USCG responsible for investigating and preparing report of fires, spillage, injury, fatality and blowouts and collisions and allisions), and offshore facility system/subsystem responsibility matrix (identifies lead agency responsible for MODU, fixed, and floating systems and subsystems, and coordinates with other agencies as appropriate).

On April 18, 2005, this Agency and USCG met to identify MOA's that needed to be developed and to prioritize work. The following subject areas were selected: (a) civil penalties; (b) incident investigations; (c) offshore security; (d) oil-spill planning, preparedness, and response; (e) deepwater ports; (f) digital databases; (g) MODU's; (h) fixed platforms; (i) floating platforms; (j) floating, production, storage, and offloading units (FPSO's); and (k) incident reporting. Joint agency teams have been established to develop the MOA's for the first five subject areas. In addition, an MOA is also being pursued to address renewable energy and alternate use of the OCS. The Civil Penalties MOA-OCS-02 was approved on September 12, 2006. The Oil Discharge Planning, Preparedness, and Response MOA-OCS-03 became effective on May 23, 2009, and the Incident Investigation MOA-OCS-03 became effective on March 27, 2009.

CHAPTER 2

ALTERNATIVES INCLUDING THE PROPOSED ACTION

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

This Supplemental EIS addresses one areawide oil and gas lease sale in the WPA of the Gulf of Mexico OCS (**Figure 1-1**), as scheduled in the current *Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012* (5-Year Program; USDOI, MMS, 2007c). The proposed action (proposed lease sale) includes regulations in place at the time a Record of Decision is made for this Supplemental EIS and lease stipulations. As a result of the DWH event, there are multiple groups and bodies that have been impaneled to offer recommendations on how OCS regulations may be changed (**Table 2-1**). Some of these inquiries have concluded their business and some have not. On October 14, 2010, the new interim final rules for drilling safety in OCS operations were published in the *Federal Register* (2010b). On October 15, 2010, the final rule for OCS safety and environmental management systems was published in the *Federal Register* (2010a). **Chapter 1.3.1** explains these regulatory changes, which are part of the proposed action and all alternatives.

2.1. SUPPLEMENTAL EIS NEPA ANALYSIS

This Supplemental EIS tiers from the Multisale EIS and the 2009-2012 Supplemental EIS. Its purpose is to determine if new information is substantial enough to alter the conclusions stated in the Multisale EIS and the 2009-2012 Supplemental EIS and, if so, to disclose those changes. This includes all new information and not just that acquired since the DWH event. This Agency utilized the best information available derived from ongoing and past research to determine if the baseline condition for resources had changed since the Multisale EIS and the 2009-2012 Supplemental EIS due to the DWH event or any other factor. This Supplemental EIS presents an impartial analysis of new information that is available through sources open to Agency experts.

This Supplemental EIS was prepared in consideration of the potential changes to the baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of the DWH event. The environmental resources include sensitive coastal environments, offshore benthic resources, marine mammals, sea turtles, coastal and marine birds, endangered and threatened species, and fisheries. This Supplemental EIS also considered the DWH event in the analysis of the potential alternatives of the proposed action.

It must be understood that this Supplemental EIS analyzes the proposed action and alternatives for the proposed WPA lease sale. This is not an EIS on the DWH event, although information on this event is being analyzed as it applies to resources in the WPA. As per the recommendation by the Council on Environmental Quality in the August 16, 2010, report titled *Report Regarding the Minerals Management Service's National Environmental Policy Act Policies, Practices, and Procedures as They Relate to Outer Continental Shelf Oil and Gas Exploration and Development* (Council on Environmental Quality, 2010), an analysis of the impacts of low-probability catastrophic spills has been prepared and is included as **Appendix B**.

2.2. ALTERNATIVES, MITIGATING MEASURES, AND ISSUES

2.2.1. Alternatives

2.2.1.1. Alternatives for Proposed Western Planning Area Lease Sale 218

The following alternatives were included for analysis in the Multisale EIS and the 2009-2012 Supplemental EIS and are described in detail in **Chapter 2.3**. As explained in **Chapter 2.2.1.3**, the Use of a Nomination and Tract Selection Leasing System Alternative was not included for analysis in this Supplemental EIS because of an ongoing BOEMRE study on alternative approaches to leasing.

Alternative A—The Proposed Action: This is the Agency's preferred alternative. This alternative would offer for lease all unleased blocks within the WPA for oil and gas operations (**Figure 2-1**), except whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary and whole and partial blocks in the Western Gap buffer area.

The WPA sale area encompasses about 28.7 million ac. Approximately 18.3 million ac (64%) of the WPA sale area is currently unleased. The estimated amount of resources projected to be developed as a result of the proposed WPA lease sale is 0.222-0.423 BBO and 1.495-2.647 Tcf of gas.

Alternative B—The Proposed Action Excluding the Unleased Blocks Near Biologically Sensitive Topographic Features: This alternative would offer for lease all unleased blocks in the WPA, as described for the proposed action (Alternative A), with the exception of any unleased blocks subject to the Topographic Features Stipulation.

Alternative C—No Action: This is the cancellation of the proposed WPA lease sale. The opportunity for development of the estimated 0.222-0.423 BBO and 1.495-2.647 Tcf of gas that could have resulted from the proposed WPA lease sale would be precluded or postponed. Any potential environmental impacts resulting from the proposed lease sale would not occur or would be postponed. This is also analyzed in the EIS for the 5-Year Program on a nationwide programmatic level.

2.2.1.2. Alternatives Considered but Not Analyzed

Alternatives to Areawide Leasing

The Multisale EIS forecasted a future analysis for Use of a Nomination and Tract Selection Leasing System Alternative for both a WPA and CPA proposed lease sale. Since the publication of the Multisale EIS, this Agency has contracted a study of leasing policy alternatives that may serve to further the many goals of the OCSLA.

The study began in October 2007 and at that time was expected to take about 18 months to complete. This Agency received a final version of the original study in the third quarter of FY 2009. The study evaluated different leasing options, some pertaining to the alternative size of areas offered for leasing and some pertaining to alternative lease terms and conditions. Options for alternative sizes included areawide annual, areawide every other year, or 5 percent of areawide as a proxy for nomination scale. Options for alternative lease terms and conditions included different royalty rates, minimum bid or rental amounts, profit shares, work commitments, multi-round bidding, and shorter primary terms. No combination of options was provisionally found superior to the current system on all performance measures. The performance measures against which the alternatives were evaluated included expeditious and orderly development of resources, fair return for leased resources, promotion of competition, equitable sharing of the costs and benefits of offshore leasing, facilitation of regional planning, minimizing environmental risks, and maximizing social value.

In January 2010, this Agency modified the original contract to have an additional scenario (growth in resource size from the most current estimates) run through the original contractor's model. Then, after the DWH event, BOEMRE did a second contract modification to address scenarios involving a drilling pause and a delay in future lease sales such as is occurring now. When this additional work is delivered, BOEMRE will reconsider alternative leasing scenarios. Informed by this study and recent events, future leasing decisions could result in fewer sales, smaller sale sizes, or higher fees, any of which would more simply and directly serve many of the same purposes as tract nomination sales. The recommendations from multiple Secretarial and Presidential inquiries (**Table 2-1**) are likely to include stricter drilling and safety requirements that would need to be considered in conjunction with leasing system alternatives. It is possible that future leasing decisions could result directly or indirectly in fewer blocks leased per sale or fewer sales held per year, leading ultimately to fewer blocks drilled and developed.

Pending completion of the revised scope of work for the alternative leasing system analysis within the wider context of possible or likely regulatory changes, BOEMRE believes that it is not appropriate to include the Use of a Nomination and Tract Selection Leasing System Alternative in this Supplemental EIS.

2.2.2. Mitigating Measures

The NEPA process is intended to help public officials make decisions that are based on an understanding of environmental consequences and to take actions that protect, restore, and enhance the environment. Agencies are required to identify and include in the alternative chosen all relevant and reasonable mitigation measures that could improve the action. Section 1508.20 of the CEQ regulations define mitigation as

- Avoidance—Avoiding an impact altogether by not taking a certain action or part of an action.
- Minimization—Minimizing impacts by limiting the intensity or magnitude of the action and its implementation.
- Restoration—Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
- Maintenance—Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
- Compensation—Compensating for the impact by replacing or providing substitute resources or environments.

2.2.2.1. Proposed Mitigating Measures Analyzed

The potential mitigating measures included for analysis in this Supplemental EIS were developed as the result of scoping efforts over a number of years for the continuing OCS Program in the Gulf of Mexico. Four lease stipulations are proposed for WPA Lease Sale 218—the Topographic Features Stipulation, the Military Areas Stipulation, the Protected Species Stipulation, and the Law of the Sea Convention Royalty Payment Stipulation. The Law of the Sea Convention Royalty Payment Stipulation is applicable to WPA Lease Sale 218 even though it is not an environmental or military stipulation. The Naval Mine Warfare Area Stipulation is no longer applicable to the WPA lease sale area by memorandum dated April 3, 2009, from the Department of the Navy.

These measures will be considered for adoption by the ASLM, under authority delegated by the Secretary of the Interior. The analysis of any stipulations for Alternative A does not ensure that the ASLM will make a decision to apply the stipulations to leases that may result from any proposed lease sale nor does it preclude minor modifications in wording during subsequent steps in the prelease process if comments indicate changes are necessary or if conditions change.

Any stipulations or mitigation requirements to be included in a lease sale will be described in the ROD for that lease sale. Mitigating measures in the form of lease stipulations are added to the lease terms and are therefore enforceable as part of the lease. In addition, each exploration and development plan, as well as any pipeline applications that may result from the lease sale, will undergo a NEPA review, and additional project-specific mitigations are routinely applied as conditions of plan approval. The BOEMRE has the authority to monitor and enforce these conditions, and under 30 CFR 250 Subpart N, may seek remedies and penalties from any operator that fails to comply with the conditions of permit approvals, including stipulations and other mitigating measures.

2.2.2.2. Existing Mitigating Measures

This section discusses only mitigating measures that would be applied by BOEMRE. Mitigating measures have been proposed, identified, evaluated, or developed through previous BOEMRE lease sale NEPA review and analysis. Many of these mitigating measures have been adopted and incorporated into regulations and/or guidelines governing OCS exploration, development, and production activities. All plans for OCS activities (e.g., exploration and development plans, pipeline applications, and structure-removal applications) go through rigorous BOEMRE review and approval to ensure compliance with established laws and regulations. Existing mitigating measures must be incorporated and documented in plans submitted to BOEMRE. Operational compliance of these mitigating measures is enforced through BOEMRE's onsite inspection program.

Mitigating measures are a standard part of BOEMRE's program to ensure that the operations are always conducted in an environmentally sound manner (with an emphasis on minimizing any adverse impact of routine operations on the environment). For example, mitigating measures ensure site clearance procedures that eliminate potential snags to commercial fishing nets and that, as appropriate, may require surveys to detect and avoid archaeological sites and biologically sensitive areas such as pinnacles, topographic features, and chemosynthetic communities.

Some BOEMRE-identified mitigating measures are incorporated into OCS operations through cooperative agreements or efforts with industry and various State and Federal agencies. These mitigating measures include NMFS's Observer Program to protect marine mammals and sea turtles during explosive removals, labeling operational supplies to track possible sources of debris or equipment loss, development of methods of pipeline landfall to eliminate impacts to beaches or wetlands, and beach cleanup events.

Site-specific mitigating measures are also applied by BOEMRE during plan and permit reviews. The BOEMRE realized that many of these site-specific mitigations were recurring and developed a list of "standard" mitigations. There are currently over 120 standard mitigations. The wording of a standard mitigation is developed by BOEMRE in advance and may be applied whenever conditions warrant. Standard mitigation text is revised as often as is necessary (e.g., to reflect changes in regulatory citations, agency/personnel contact numbers, and internal policy). Site-specific mitigation "categories" include the following: air quality; archaeological resources; artificial reef material; chemosynthetic communities; Flower Garden Banks; topographic features; hard bottoms/pinnacles; military warning areas and Eglin Water Test Areas (EWTA's); Naval mine warfare areas; hydrogen sulfide; drilling hazards; remotely operated vehicle surveys; geophysical survey reviews; and general safety concerns. Site-specific mitigation "types" include the following: advisories; conditions of approval; hazard survey reviews; inspection requirements; notifications; post-approval submittals; and safety precautions. In addition to standard mitigations, BOEMRE may also apply nonrecurring mitigating measures that are developed on a case-by-case basis.

The BOEMRE is continually revising applicable mitigations to allow the Gulf of Mexico Region to more easily and routinely track mitigation compliance and effectiveness. A primary focus of this effort is requiring post-approval submittal of information within a specified timeframe after a triggering event that is tracked by BOEMRE (e.g., end of operations reports for plans, construction reports for pipelines, and removal reports for structure removals).

2.2.3. Issues

Issues are defined by CEQ to represent those principal "effects" that an EIS should evaluate in-depth. Scoping identifies specific environmental resources and/or activities rather than "causes" as significant issues (CEQ Guidance on Scoping, April 30, 1981). The analysis in the EIS can then show the degree of change from present conditions for each issue due to the relevant actions related to the proposed action.

Selection of environmental and socioeconomic issues to be analyzed was based on the following criteria:

- issue is identified in CEQ regulations as subject to evaluation;
- the relevant resource/activity was identified through agency expertise, through the scoping process, or from comments on past EIS's;
- the resource/activity may be vulnerable to one or more of the impact-producing factors associated with the OCS Program; a reasonable probability of an interaction between the resource/activity and impact-producing factor should exist; or
- information that indicates a need to evaluate the potential impacts to a resource/activity has become available.

2.2.3.1. Issues to be Analyzed

Like the Multisale EIS and the 2009-2012 Supplemental EIS, this Supplemental EIS addresses issues related to potential impact-producing factors and the environmental and economic resources and activities that could be affected by OCS exploration, development, production, and transportation activities. A reevaluation of affected environmental resources based on the effects of the DWH event is warranted. The baseline condition of some resources has been changed, some to a greater degree than others, and preparation of this Supplemental EIS was judged by BOEMRE to be appropriate for this evaluation of the one remaining WPA lease sale in the 5-Year Program

2.2.3.2. Issues Considered but Not Analyzed

As previously noted, the CEQ regulations for implementing NEPA instruct agencies to adopt an early process (termed "scoping") for determining the scope of issues to be addressed and for identifying significant issues related to a proposed action. As part of this scoping process, agencies shall identify and eliminate from detailed study the issues that are not significant to the proposed action or have been covered by prior environmental review.

Through our scoping efforts, numerous issues and topics were identified for consideration in the Multisale EIS, the 2009-2012 Supplemental EIS, and this Supplemental EIS. After careful evaluation and study, the following categories were considered not to be significant issues related to the proposed action or that have been covered by prior environmental review.

Program and Policy Issues

Comments and concerns that relate to program and policy are issues under the direction of the Department of the Interior and/or BOEMRE, and their guiding regulations, statutes, and laws. The comments and concerns related to program and policy issues are not considered to be specifically related to the proposed action. Such comments are forwarded to the appropriate program offices for their consideration. Programmatic issues including expansion of the sale area, administrative boundaries, and royalty relief have been considered in the preparation of the EIS for the 5-Year Program.

Revenue Sharing

A number of comments were received on previous EIS's from State and local governments, interest groups, and the general public stating that locally affected communities should receive an increased share of revenues generated by the OCS oil and gas leasing program. This increased revenue would act as mitigation of OCS-related impacts to coastal communities including impacts to Louisiana Highway 1 (LA Hwy 1) and Lafourche Parish, Louisiana, from OCS-related activity at Port Fourchon. Comments and concerns that relate to the use and distribution of revenues are issues under the direction of the U.S. Congress or the Department of the Interior, and their guiding regulations, statutes, and laws.

The BOEMRE distributes revenues collected from Federal mineral leases to special-purpose funds administered by Federal agencies; to States; and to the General Fund of the U.S. Department of the Treasury. Legislation and regulations provide formulas for the disbursement of these revenues. The distribution of revenues is discussed in Chapter 3.3.5.2 of the Multisale EIS.

With the enactment of GOMESA, the Gulf producing States (i.e., Texas, Louisiana, Mississippi, and Alabama) and their coastal political subdivisions (CPS's) were granted an increased share of offshore oil and gas revenue. Beginning in FY 2007, and thereafter, Gulf producing States and their CPS's received 37.5 percent of the qualified OCS revenue from new leases issued in the 181 Area in the EPA and the 181 South Area. Beginning in FY 2016, and thereafter, Gulf producing States and their CPS's will receive 37.5 percent and the Land and Water Conservation Fund will receive 12.5 percent of qualified OCS revenue from new leases in the existing areas available for leasing, subject to a $500 million cap. The remaining 50 percent of qualified OCS revenues and revenues exceeding the $500 million cap will be distributed to the U.S. Treasury.

The socioeconomic benefits and impacts to local communities are analyzed in **Chapter 4** of this Supplemental EIS.

2.3. PROPOSED WESTERN PLANNING AREA LEASE SALE 218

The following three alternatives were included for analysis in the Multisale EIS and the 2009-2012 Supplemental EIS. As explained in **Chapter 2.2.3.2**, the Use of a Nomination and Tract Selection Leasing System Alternative was not included for analysis in this Supplemental EIS because of an ongoing BOEMRE study on alternative approaches to leasing.

2.3.1. Alternative A—The Proposed Action

2.3.1.1. Description

Alternative A would offer for lease all unleased blocks within the WPA for oil and gas operations (**Figure 2-1**), except whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary and whole and partial blocks in the Western Gap buffer area.

The WPA sale area encompasses about 28.7 million ac. Approximately 18.3 million ac (64%) of the WPA sale area is currently unleased. The estimated amount of resources projected to be developed as a result of any one proposed WPA lease sale is 0.222-0.423 BBO and 1.495-2.647 Tcf of gas.

The analyses of impacts summarized below and described in detail in **Chapter 4** are based on the development scenario, which is a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. A detailed discussion of the development scenario and major related impact-producing factors is included in **Chapter 3**.

2.3.1.2. Summary of Impacts

Air Quality (Chapter 4.1.1.1)

Emissions of pollutants into the atmosphere from the routine activities associated with the WPA proposed action are projected to have minimal impacts to onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline. Emissions from proposed-action activities are expected to be well within the NAAQS. As indicated in the Gulf of Mexico Air Quality Study and other modeling studies, the proposed action would have only a small effect on ozone levels in ozone nonattainment areas and would not interfere with the States' schedule for compliance with the National Ambient Air Quality Standards (NAAQS). The OCD modeling results show that increases in onshore annual average concentrations of NO_x, SO_x, and PM_{10} are estimated to be less than the maximum increases allowed in the Prevention of Significant Deterioration Class II areas. Regulations, monitoring, mitigation, and developing emissions-related technologies would ensure these levels stay within the NAAQS.

Accidental events associated with the WPA proposed action that could impact air quality include spills of oil, natural gas, condensate, and refined hydrocarbons; H_2S release; fire; and NAAQS air pollutants (i.e., SO_x, NO_x, VOC's, CO, PM_{10}, and $PM_{2.5}$). Response activities that could impact air quality include in-situ burning, the use of flares to burn gas and oil, and the use of dispersants applied from aircraft. Measurements taken during an in-situ burning show that a major portion of compounds was consumed in the burn; therefore, pollutant concentrations would be expected to be within the NAAQS. In a recent analysis of air in coastal communities, low levels of dispersants were identified. These response activities are temporary in nature and occur offshore; therefore, there are little expected impacts from these actions to onshore air quality. Accidents involving high concentrations of H_2S could result in deaths as well as environmental damage. Regulations and NTL's are in place to protect workers from H_2S releases. Other emissions of pollutants into the atmosphere from accidental events as a result of the WPA proposed action are not projected to have significant impacts on onshore air quality because of the prevailing atmospheric conditions, emissions height, emission rates, and the distance of these emissions from the coastline. These emissions are not expected to have concentrations that would change onshore air quality classifications.

Overall, since loss of well-control events and blowouts are rare events and of short duration, potential impacts to air quality are not expected to be significant, except in the rare case of a catastrophic event. The summary of vast amounts of data collected and additional studies will provide more information in the future.

Water Quality

Coastal Waters (Chapter 4.1.1.2.1)

The primary impacting sources to water quality in coastal waters are point-source and storm-water discharges from support facilities, vessel discharges, and nonpoint-source runoff. These activities are not only highly regulated but are also localized and temporary in nature. The impacts to coastal water quality from routine activities associated with the WPA proposed action should be minimal because of the distance to shore of most routine activities, USEPA regulations that restrict discharges, and the few if any new pipeline landfalls or onshore facilities that would be constructed, .

Accidental events associated with the WPA proposed action that could impact coastal water quality include spills of oil and refined hydrocarbons, releases of natural gas and condensate, spills of chemicals or drilling fluids. The loss of well control, pipeline failures, collisions, or other malfunctions could also result in such spills. Although response efforts may decrease the amount of oil in the environment, the response efforts may also impact the environment through, for example, increased vessel traffic, hydromodification, and application of dispersants. Natural degradation processes would also decrease the amount of spilled oil over time. For coastal spills, two additional factors that must be considered are the shallowness of the area the spill is in and the proximity of the spill to shore. Over time, natural processes can physically, chemically, and biologically degrade oil. Chemicals used in the oil and gas industry are not a significant risk in the event of a spill because they are either nontoxic, used in minor quantities, or are only used on a noncontinuous basis. Spills from collisions are not expected to be significant because collisions occur infrequently.

Offshore Waters (Chapter 4.1.1.2.2)

During exploratory activities, the primary impacting sources to offshore water quality are discharges of drilling fluids and cuttings. During platform installation and removal activities, the primary impacting sources to water quality are sediment disturbance and temporarily increased turbidity. Impacting discharges during production activities are produced water and supply-vessel discharges. Regulations are in place to limit the levels of contaminants in these discharges. Pipeline installation can also affect water quality by sediment disturbance and increased turbidity. Service-vessel discharges might include water with oil concentration of approximately 15 ppm, as established by regulatory standards. Any disturbance of the seafloor would increase turbidity in the surrounding water, but the increased turbidity should be temporary and restricted to the area near the disturbance. There are multiple Federal regulations and permit requirements that would decrease the magnitude of these activities. Impacts to offshore waters from routine activities associated with the WPA proposed action should be minimal as long as regulatory requirements are followed.

Accidental events associated with the WPA proposed action that could impact offshore water quality include spills of oil and refined hydrocarbons, releases of natural gas and condensate, spills of chemicals or drilling fluids, and loss of well control, pipeline failures, collisions, or other malfunctions that would result in such spills. Spills from collisions are not expected to be significant because collisions occur infrequently. Overall, since loss of well control events and blowouts are rare events, and usually of short duration, potential impacts to offshore water quality are not expected to be significant except in the rare case of a catastrophic event (**Appendix B**). Although response efforts may decrease the amount of oil in the environment, the response efforts may also impact the environment through, for example, increased vessel traffic and application of dispersants. Natural physical, chemical, and biological degradation processes would also decrease the amount of spilled oil over time through dilution, weathering, and degradation of the oil. Chemicals used in the oil and gas industry are not a significant risk for a spill because they are either nontoxic, used in minor quantities, or are only used on a noncontinuous basis. Although there is the potential for accidental events, the WPA proposed action would not significantly change the water quality of the Gulf of Mexico over a large spatial or temporal scale.

Coastal Barrier Beaches and Associated Dunes (Chapter 4.1.1.3)

Effects to coastal barrier beaches and associated beaches from pipeline emplacements, navigation channel use and dredging, and construction or continued use of infrastructure in support of the WPA proposed action are expected to be restricted to temporary and localized disturbances. The 0-1 pipeline landfalls projected in support of the proposed action are not expected to cause significant impacts to barrier beaches because of the use of nonintrusive installation methods and regulations. The 0-1 gas processing plants would also not be expected to be constructed on barrier beaches. Existing facilities originally built inland may, due to natural erosion and shoreline recession, eventually be located in the barrier beach and dune zone and contribute to erosion there. The proposed action may contribute to the continued use of such facilities.

Maintenance dredging of barrier inlets and bar channels is expected to occur, which combined with channel jetties, generally causes minor and localized impacts on adjacent barrier beaches downdrift of the channel. These dredging activities are permitted, regulated, and coordinated by COE with the appropriate State and Federal resource agencies. Impacts from these operations are minimal due to requirements for the beneficial use of the dredged material for wetland and beach construction and restoration. Permit requirements further mitigate dredged material placement in approved disposal areas by requiring the dredged material to be placed in such a manner that it neither disrupts hydrology nor changes elevation in the surrounding marsh. Based on use, the proposed action would account for a very small percentage of these impacts, and this would occur whether the proposed action is implemented or not.

In conclusion, the WPA proposed action is not expected to adversely alter barrier beach configurations significantly beyond existing, ongoing impacts in localized areas downdrift of artificially jettied and maintained channels. The proposed action may extend the life and presence of existing facilities in eroding areas through modifications to channel training structures (jetties) and the utilization of beach restoration and nourishment techniques combined with dune restoration. Strategic placement of dredged material from channel maintenance, channel deepening, and related actions can mitigate adverse impacts upon those localized areas.

Because of the proximity of inshore spills to barrier islands and beaches, these inshore spills pose the greatest threat because of its concentration and lack of weathering by the time it hits the shore and because dispersants are not an effective means of spill response. Such spills may result from either vessel collisions that release fuel and lubricants or from pipelines that rupture. Impacts of a nearshore spill would be considered short term in duration and minor in scope because the size of such a spill is projected to be small (coastal spills are assumed to be 5 bbl; Table 4-13 of the Multisale EIS). Offshore-based crude oil would be less in toxicity when it reaches the coastal environments. This is due to the distance from shore, the weather, the time the oil remains offshore, and the dispersant used. Equipment and personnel used in cleanup efforts can generate the greatest direct impacts to the area, such as mechanized cleanup equipment (e.g., sifters) that would disperse oil deeper into sands and sediments, and foot traffic that would impact the distribution of oils and marsh vegetation. Close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize those impacts.

The BOEMRE has reexamined the analysis for barrier island and beach resources presented in the Multisale EIS, based on the additional information presented above. Although the most current information did reveal that some of the barrier islands had experienced storm-induced reductions in beach shoreline elevations and erosion, the significance of this loss of protection is small in comparison with the overriding climatic forces. Therefore, this information would not alter the overall conclusion that impacts on barrier islands and beaches from accidental impacts associated with the WPA proposed action would be minimal. Should a spill other than a catastrophic spill contact a barrier beach, oiling is expected to be light and sand removal during cleanup activities minimized. No significant long-term impacts to the physical shape and structure of barrier beaches and associated dunes are expected to occur as a result of the WPA proposed action. The current lease sale would not pose a significant increase in risk to barrier island or beach resources.

Wetlands (Chapter 4.1.1.4)

The WPA proposed action is projected to contribute to the construction of 0-1 new onshore pipelines. Modern pipelaying techniques and mitigations would be used for such a project. Modern pipelaying techniques use selective placement and directional drilling to avoid wetlands, reduce the reliance on trenching, and require restoration; thus, the projected impact to wetlands from pipeline emplacement is expected to be negligible. Because of permit requirements, modern techniques, and mitigation, activities associated with the proposed action are expected to cause negligible to low impacts to wetlands. Secondary impacts to wetlands are caused by existing pipeline and vessel traffic corridors, and these would continue to cause landloss due to erosion. Any potential impacts from the proposed action would be reduced through the continued use of armored channels and modern erosion techniques.

Offshore oil spills resulting from the WPA proposed action are not expected to extensively damage any wetlands along the Gulf Coast. This is because of the distance of the spill to the coast and because wetlands are generally protected by barrier islands, peninsulas, sand spits, and currents. Although the probability of occurrence is low, the greatest threat of an oil spill to wetland habitat is from an inland spill as a result of a vessel accident or pipeline rupture. Wetlands in the northern Gulf of Mexico are either in moderate- to high-energy environments; therefore, sediment transport and tidal stirring should reduce the chances for oil persisting in the event that these areas are oiled. While a resulting slick may cause minor impacts to wetland habitat, the equipment and personnel used to clean up the spill can generate the greatest impacts to the area. Associated foot traffic can work oil farther into the sediment than would otherwise occur. Close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize those impacts. Overall, impacts to wetland habitats from an oil spill associated with activities related to the WPA proposed action would be expected to be low and temporary because of the nature of the system, regulations, and specific cleanup techniques.

Seagrass Communities (Chapter 4.1.1.5)

Routine OCS activities in the WPA that may impact seagrasses are not predicted to significantly increase in occurrence and range in the near future, with minimal associated nearshore activities and infrastructure, such as the projected one new pipeline landfall. Requirements of other Federal and State programs, such as avoidance of the seagrass and vegetation communities or the use of turbidity curtains, reduce undesirable effects on submerged vegetation beds from dredging activities. Federal and State permit requirements should ensure that pipeline routes avoid high-salinity beds and maintain water clarity and quality. Local programs decrease the occurrence of prop scarring in grass beds, and channels utilized by OCS vessels are generally away from exposed submerged vegetation beds. Because of these requirements and implemented programs, along with the beneficial effects of natural flushing (e.g., from winds and currents), any potential effects from routine activities on submerged vegetation in the WPA are expected to be localized and not significantly adverse.

Although the probability of their occurrence is low, the greatest threat to inland, submerged vegetation communities would be from an inland spill resulting from a vessel accident or pipeline rupture. The resulting slick may cause short-term and localized impacts to the bed. There is also the remote possibility of an offshore spill to such an extent that it could also affect submerged vegetation beds, and this would have similar effects to an inshore spill. Because prevention and cleanup measures can have negative effects on submerged vegetation, close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize those impacts. The floating nature of nondispersed crude oil, the regional microtidal range, dynamic climate with mild temperatures, and the amount of microorganisms that consume oil would alleviate prolonged effects on submerged vegetation communities. Also, safety and spill-prevention technologies continue to improve and will decrease the detrimental effects to submerged vegetation from the WPA proposed action.

Topographic Features (Chapter 4.1.1.6)

The proposed Topographic Features Stipulation, if applied, would prevent most of the potential impacts on topographic features from bottom-disturbing activities (structure removal and emplacement) and operational discharges associated with the WPA proposed action through avoidance, by requiring individual activities to be located at specified distances from the feature or zone. Because of the No Activity Zone, permit restrictions, and the high-energy environment associated with topographic features, if any contaminants reach topographic features, they would be diluted from their original concentration, and impacts that do occur would be minimal.

Effects of the Proposed Action without the Proposed Stipulation

The topographic features and associated coral reef biota of the WPA could be adversely impacted by oil and gas activities resulting from the proposed action in the absence of the proposed Topographic Features Stipulation. This would be particularly true should operations occur directly on top of or in the immediate vicinity of otherwise protected WPA topographic features.

The No Activity Zone of the topographic features would be most susceptible to adverse impacts if oil and gas activities are unrestricted without the proposed Topographic Feature Stipulation and not followed up by mitigating measures. These impacting activities could include vessel anchoring and infrastructure emplacement; discharges of drilling muds, cuttings, and produced water; and ultimately the explosive removal of structures. All of the above-listed activities have the potential to considerably alter the diversity, cover, and long-term viability of the reef biota found within the No Activity Zone. In most cases, recovery from disturbances would take 10 years or more. Long-lasting and possibly irreversible change would be caused mainly by vessel anchoring and structure emplacement (pipelines, drill rigs, and platforms). Such activities would physically and mechanically alter benthic substrates and their associated biota. Operational discharges would cause substantial and prolonged turbidity and sedimentation, possibly impeding the well-being and permanence of the biota and interfering with larval settlement, resulting in the decrease of live benthic cover. Finally, the unrestricted use of explosives to remove platforms installed in the vicinity of or on the topographic features could cause turbidity, sedimentation, and shock-wave impacts that would affect reef biota.

The shunting of cuttings and fluids, which would be required by the Topographic Features Stipulation, is intended to limit the smothering and crushing of sensitive benthic organisms caused by depositing foreign substances onto the topographic features. The impacts from unshunted exploration and development discharges of drill cuttings and drilling fluids within the 1,000-Meter Zone, 1-Mile Zone, and 4-Mile Zone would definitely impact the biota of topographic features. Specifically, the discharged materials would cause prolonged events of turbidity and sedimentation, which could have long-term deleterious effects on local primary production, predation, and consumption by benthic and pelagic organisms, biological diversity, and benthic live cover. The unrestricted discharge of operational effluents would be a further source of impact to the sensitive biological resources of the topographic features. Therefore, in the absence of the proposed Topographic Features Stipulation, the proposed action could cause long-term (10 years or more) adverse impacts to the biota of the topographic features.

The proposed Topographic Features Stipulation, if applied, would assist in preventing most of the potential impacts on topographic feature communities from blowouts, surface, and subsurface oil spills and the associated effects by increasing the distance of such events from the topographic features. It would be expected that the majority of oil would rise to the surface and the most heavily oiled sediments would likely be deposited before reaching the topographic features. Any contact with spilled oil would likely cause sublethal effects to benthic organisms because the distance of activity would prevent contact with concentrated oil. In the unlikely event that oil from a subsurface spill would reach the biota of a topographic feature, the effects would be primarily sublethal and impacts would be at the community level. Any turbidity, sedimentation, and oil adsorbed to sediment particles would also be at low concentrations by the time the topographic features were reached, also resulting in sublethal impacts. Impacts from an oil spill on topographic features are also lessened by the distance of the spill to the features, the depth of the features, and the currents that surround the features.

The topographic features and associated coral reef biota of the WPA could be damaged by oil and gas activities resulting from the proposed action should they not be restricted by application of the proposed Topographic Features Stipulation. This would be particularly true should operations occur directly on top of or in the immediate vicinity of otherwise protected topographic features. The area within the No Activity Zone would probably be the areas of the topographic features that are most susceptible to adverse impacts if oil and gas activities are unrestricted by the proposed Topographic Features Stipulation or project-specific mitigating measures. These impacting factors would include blowouts, surface oil spills, and subsea oil spills, along with oil-spill-response activities such as the use of dispersants. Potential impacts from routine activities resulting from the proposed action are discussed in **Chapter 4.1.1.6.2**.

Oil spills as well as routine activities have the potential to considerably alter the diversity, cover, and long-term viability of the reef biota found within the No Activity Zone if the proposed Topographic Features Stipulation is not applied. Direct oil contact may result in acute toxicity. In most cases, recovery from disturbances would take 10 years or more. Dispersants should not be applied near sensitive areas such as coral communities according to NOAA Policy. Although not specifically regulated by BOEMRE's proposed stipulation, their possible use is physically distanced by buffer zones created by BOEMRE stipulations. Dispersants could be applied at a spill close to sensitive features if the buffer zone between petroleum-producing activity and a sensitive feature is not enforced through stipulations. Indeed, disturbances, including oil spills and blowouts, would alter benthic substrates and their associated biota over large areas. In the unlikely event of a blowout, sediment resuspension potentially associated with oil could cause adverse turbidity and sedimentation conditions. In addition to affecting the live cover of a topographic feature, a blowout could alter the local benthic morphology, thus irreversibly altering the reef community. Oil spills (surface and subsea) could be harmful to the local biota should the oil have a prolonged or recurrent contact with the organisms. Therefore, in the absence of the proposed Topographic Features Stipulation, the proposed action could cause long-term (10 years or more) adverse impacts to the biota of the topographic features in the event of a spill.

Sargassum (Chapter 4.1.1.7)

Sargassum, as pelagic algae, is a widely distributed resource that is ubiquitous throughout the GOM and northwest Atlantic. Considering its ubiquitous distribution and occurrence in the upper water column near the sea surface, it would be contacted by routine discharges from oil and gas operations. All types of discharges including drill muds and cuttings, produced water, and operational discharges (e.g., deck runoff, bilge water, sanitary effluent, etc.) would contact *Sargassum* algae. However, the quantity and volume of these discharges is relatively small compared with the pelagic waters of the WPA (115,645 km^2; 44,651 mi^2). Therefore, although discharges would contact *Sargassum*, they would only contact a very small portion of the *Sargassum* population. Likewise, impingement effects by service vessels and working platforms and drillships would contact only a very small portion of the *Sargassum* population. Because these discharges are highly regulated for toxicity and because they would continue to be diluted in the Gulf water, reducing concentrations of any toxic component, produced-water impacts on *Sargassum* would be minimum. The impacts to *Sargassum* that are associated with the proposed action are expected to have only minor effects to a small portion of the *Sargassum* community as a whole. The *Sargassum* community lives in pelagic waters with generally high water quality and would be resilient to the minor effects predicted. It has a yearly cycle that promotes quick recovery from impacts. No measurable impacts are expected to the overall population of the *Sargassum* community.

Considering its ubiquitous distribution and occurrence in the upper water column near the sea surface, it would contact potential accidental spills from oil and gas operations. All types of spills, including surface oil and fuel spills, underwater well blowouts, and chemical spills, would contact *Sargassum* algae. The quantity and volume of most of these spills would be relatively small compared with the pelagic waters of the WPA (115,645 km^2; 44,651 mi^2). Therefore, most spills would only contact a very small portion of the *Sargassum* population. The impacts to *Sargassum* that are associated with the proposed action are expected to have only minor effects to a small portion of the *Sargassum* community unless a catastrophic spill occurs. In the case of a very large spill, the *Sargassum* algae community could suffer severe impacts to a sizable portion of the population in the northern GOM. The *Sargassum* community lives in pelagic waters with generally high water quality and is expected to show good resilience to the predicted effects of spills. It has a yearly cycle that promotes quick recovery from impacts. No measurable impacts are expected to the overall population of the *Sargassum* community unless a catastrophic spill occurs.

Chemosynthetic Deepwater Benthic Communities (Chapter 4.1.1.8)

Chemosynthetic communities are susceptible to physical impacts from structure placement (including templates or subsea completions), anchoring, and pipeline installation. Without mitigation measures, these activities could result in the smothering by suspension of sediments or crushing of organisms residing in these communities. Because of the guidelines described in NTL 2009-G40, the risk of these physical impacts are greatly reduced by requiring the avoidance of potential chemosynthetic communities. Information included in required hazards surveys for oil and gas activities depicts areas that could potentially harbor chemosynthetic communities. This allows BOEMRE to require avoidance of any areas that are conducive to chemosynthetic growth.

The BOEMRE has reexamined the analysis for impacts to chemosynthetic communities presented in the Multisale EIS and in the 2009-2012 Supplemental EIS, based on the additional information presented above. No substantial new information was found that would alter the overall conclusion that impacts on chemosynthetic communities from routine activities associated with the WPA proposed action would be minimal to none.

Chemosynthetic communities could be susceptible to physical impacts from a blowout depending on bottom-current conditions. The guidance provided in NTL 2009-G40 greatly reduces the risk of these physical impacts. It clarifies the requirement to avoid potential chemosynthetic communities identified on the required geophysical survey records or photodocumentation to establish the absence of chemosynthetic communities prior to approval of the structure emplacement. The 2,000-ft (610-m) avoidance required would protect sensitive communities from heavy sedimentation, with only light sediment components able to reach the communities in small quantities.

Studies indicate that periods as long as hundreds of years are required to reestablish a seep community once it has disappeared (depending on the community type). There is evidence that substantial impacts on these communities could permanently prevent reestablishment, particularly if hard substrate required for recolonization was buried by resuspended sediments from a blowout.

Potential accidental impacts from the WPA proposed action are expected to cause little damage to the ecological function or biological productivity of widespread, low-density chemosynthetic communities. The rarer, widely scattered, high-density, Bush Hill-type chemosynthetic communities located at more than 610 m (2,000 ft) away from a blowout could experience minor impacts from resuspended sediments. However, the possibility of oil from a surface spill reaching a depth of 300 m (984 ft) or greater in any measurable concentration is very small. If dispersants are applied to an oil spill, oil would mix into the water column, be carried by underwater currents, and eventually contact the seafloor where it may impact patches of chemosynthetic community habitat in its path.

The BOEMRE has reexamined the analysis for impacts to chemosynthetic communities presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented above. No substantial new information was found to indicate that accidental impacts associated with the WPA proposed action would result in more than minimal impacts to chemosynthetic communities because of the NTL 2009-G40 guidelines. One exception would be in the case of a catastrophic spill combined with the application of dispersant, producing the potential to cause devastating effects on local patches of habitat in the path of subsea plumes where they contact the seafloor. If such an event were to occur, it could take hundreds of years to reestablish the chemosynthetic community in that location.

Nonchemosynthetic Deepwater Benthic Communities (Chapter 4.1.1.9)

Some impact to soft-bottom benthic communities from drilling and production activities would occur as a result of physical impact from drilling discharges, structure placement (including templates or subsea completions), anchoring, and installation of pipelines regardless of their locations. However, even in situations where the substantial burial of typical benthic infaunal communities occurred, recolonization from populations from widespread neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms.

Information included in required hazards surveys for oil and gas activities depicts areas that could potentially harbor nonchemosynthetic communities. This allows BOEMRE to require avoidance of any areas that are conducive to the growth of sensitive hard-bottom habitats. Impacts to hard-bottom communities are expected to be avoided as a consequence of the application of the existing NTL 2009-G40 guidelines for chemosynthetic communities. The same geophysical conditions associated with the potential presence of chemosynthetic communities also results in the potential occurrence of hard carbonate substrate and nonchemosynthetic communities. Because of the NTL 2009-G40 guidelines, these communities are generally avoided in exploration and development planning.

Based on the additional information presented above, BOEMRE has reexamined the analysis for impacts to nonchemosynthetic communities presented in the Multisale EIS and the 2009-2012 Supplemental EIS. No significant new information was found that would alter the overall conclusion that impacts on nonchemosynthetic communities from routine activities associated with the WPA proposed action would be minimal to none.

Accidental events resulting from the WPA proposed action are expected to cause little damage to the ecological function or biological productivity of widespread, typical, deep-sea benthic communities. Some impact to benthic communities would occur as a result of impact from an accidental blowout. Megafauna and infauna communities at or below the sediment/water interface would be impacted by the physical disturbance of a blowout or by burial from resuspended sediments. However, even in situations where the substantial burial of typical soft benthic communities occurred, recolonization by populations from neighboring substrate would be expected over a relatively short period of time. For all size ranges of organisms, this can be in a matter of hours to days for bacteria and about 1-2 years for most all macrofauna species.

Impacts to deepwater coral habitats and other potential hard-bottom communities will likely be avoided as a consequence of the application of the policies described in NTL 2009-G40. The rare, widely scattered, high-density, Bush Hill-type nonchemosynthetic communities located at more than 610 m (2,000 ft) away from a blowout could experience minor impacts from resuspended sediments. If dispersants are applied to an oil spill, oil would mix into the water column, be carried by underwater currents, and eventually contact the seafloor where it may impact patches of sensitive deepwater community habitat in its path. These potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution.

The BOEMRE has reexamined the analysis for impacts to nonchemosynthetic communities presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented above. No new information was found to indicate that accidental impacts associated with the WPA proposed action would result in more than minimal impacts to nonchemosynthetic communities. One exception would be in the case of a catastrophic spill combined with the application of dispersant, producing the potential to cause devastating effects on local patches of habitat in the path of subsea plumes where they contact the seafloor. Periods as long as hundreds of years are required to reestablish a chemosynthetic seep community once it has disappeared (depending on the community type); although, it may reappear relatively quickly once the process begins.

Marine Mammals (Chapter 4.1.1.10)

The BOEMRE has reexamined the analysis for marine mammals presented in the Multisale EIS, the 2009-2012 Supplemental EIS, and the cited new information in **Chapters 4.1.1.10.1 and 4.1.1.10.2**. Based on this evaluation, our analysis of the effects from routine activities on marine mammals remains unchanged from what was concluded in the Multisale EIS and the 2009-2012 Supplemental EIS. Effects from routine activities from the proposed WPA lease sale are not expected to have long-term adverse effects on the size and productivity of any marine mammal species or population in the northern GOM. Lethal effects, if they were to occur, could result from chance collisions with OCS service vessels or the ingestion of any accidentally released plastic materials. However, there have been no reports of mortality from these occurrences in the GOM, and vessel strikes are considered unlikely. Instead, most routine OCS activities are expected to have sublethal effects, such as behavioral effects, that are not expected to rise to the level of significance to the populations.

Although there will always be some level of incomplete information on the effects from routine activities under this proposed action on marine mammals, there is credible scientific information, applied using acceptable scientific methodologies, to support the conclusion that any realized impacts would be sublethal in nature and not in themselves rise to the level of reasonably foreseeable significant adverse (population level) effects. Also, routine activities will be ongoing in the proposed action area (WPA) as a result of existing leases and related activities. In the WPA, there are 1,394 active leases. Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that routine activities from the pre-existing OCS program are significantly impacting marine mammal populations. Therefore, a full understanding of any incomplete or unavailable information on the effects of routine activities is not essential to make a reasoned choice among the alternatives.

The analysis of the effects from accidental spills (non-catastrophic) on marine mammals remains unchanged from what was concluded in the Multisale EIS and the 2009-2012 Supplemental EIS. Impacts on marine mammals from smaller accidental events are likely to affect individual marine mammals in the spill area, as described above and within the Multisale EIS and 2009-2012 Supplemental EIS, but the impacts are unlikely to rise to the level of population effects (or significance) given the size and scope of such spills. Further, the potential remains for smaller accidental spills to occur in the proposed action area, regardless of any alternative selected under this Supplemental EIS, given there are 1,394 active leases already in this area with either ongoing or the potential for exploration, drilling, and production activities.

For low-probability catastrophic spills, the Multisale EIS, the 2009-2012 Supplemental EIS, and **Appendix B** of this Supplemental EIS conclude that there is a potential for a low-probability catastrophic event to result in significant, population-level effects on affected marine mammal species. The BOEMRE continues to concur with the conclusions from these analyses.

The BOEMRE concludes that there is incomplete or unavailable information that may lead to reasonably foreseeable significant adverse impacts to marine mammals from accidental events. For example, there is incomplete information on impacts to marine mammal populations from the DWH event. Relevant data on the status of and impacts to marine mammal populations from the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeframe contemplated in this Supplemental EIS, regardless of the cost or resources needed. In the absence of this information, BOEMRE subject-matter experts have used what scientifically credible information that is available and applied using accepted scientific methodologies. The BOEMRE does not, however, believe this incomplete information is essential to make a reasoned choice among the alternatives primarily because activities that could result in an accidental spill in the WPA would be ongoing whether or not the lease sale under the proposed action of this Supplemental EIS occurred. At present, there are 1,394 active leases in the proposed action area that are engaged, or have the potential to be engaged, in drilling and/or production activities that could theoretically result in an accidental spill. Given these existing leases and this ongoing activity, any incomplete information that may lead to reasonable foreseeable significant adverse impacts to marine mammals is not needed to make a reasoned choice among alternatives, including the No Action alternative.

Sea Turtles (Chapter 4.1.1.11)

In this Supplemental EIS, BOEMRE has reexamined the analysis for sea turtles presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and has considered the recent reports cited in **Chapters 4.1.1.11.1 and 4.1.1.11.2**. Because of the mitigations described in the analysis in **Chapters 4.1.1.11.1 and 4.1.1.11.2**, routine activities (e.g., operational discharges, noise, vessel traffic, and marine debris) related to the WPA proposed action are not expected to have long-term adverse effects on the size and productivity of any sea turtle species or populations in the northern GOM. Lethal effects could occur from chance collisions with OCS service vessels or ingestion of accidentally released plastic materials from OCS vessels and facilities. However, there have been no reports to date on such incidences. Most routine OCS energy-related activities are then expected to have sublethal effects that are not expected to rise to the level of significance.

Although there will always be some level of incomplete information on the effects from routine activities under this proposed action on sea turtles, there is credible scientific information, applied using acceptable scientific methodologies, to support the conclusion that any realized impacts would be sublethal in nature and not in themselves rise to the level of reasonably foreseeable significant adverse (population level) effects. Also, routine activities will be ongoing in the proposed action area (WPA) as a result of existing leases and related activities. In the WPA, there are 1,394 active leases. Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that routine activities from the pre-existing OCS program are significantly impacting sea turtle populations. Therefore, a full understanding of any incomplete or unavailable information on the effects of routine activities is not essential to make a reasoned choice among the alternatives.

The analysis of the effects from accidental spills (non-catastrophic) on sea turtles remains unchanged from what was concluded in the Multisale EIS and the 2009-2012 Supplemental EIS. Impacts on sea turtles from smaller accidental events are likely to affect individual sea turtles in the spill area, as described above and within the Multisale EIS and the 2009-2012 Supplemental EIS, but the impacts are unlikely to rise to the level of population effects (or significance) given the size and scope of such spills. Further, the potential remains for smaller accidental spills to occur in the proposed action area, regardless of any alternative selected under this Supplemental EIS, given there are 1,394 active leases already in this area with either ongoing or the potential for exploration, drilling, and production activities.

For low-probability catastrophic spills, the Multisale EIS, the 2009-2012 Supplemental EIS, and **Appendix B** of this Supplemental EIS conclude that there is a potential for a low-probability catastrophic event to result in significant, population-level effects on affected sea turtle species. The BOEMRE continues to concur with the conclusions from these analyses.

The BOEMRE concludes that there is incomplete or unavailable information that may lead to reasonably foreseeable significant adverse impacts to sea turtles from accidental events. For example, there is incomplete information on impacts to sea turtle populations from the DWH event. Relevant data on the status of and impacts to sea turtle populations from the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeframe contemplated in this Supplemental EIS, regardless of the cost or resources needed. In the absence of this information, BOEMRE subject-matter experts have used what scientifically credible information that is available applied using accepted scientific methodologies. The BOEMRE does not, however, believe this incomplete information is essential to make a reasoned choice among the alternatives primarily because activities that could result in an accidental spill in the WPA would be ongoing whether or not the lease sale under the proposed action of this Supplemental EIS occurred. At present, there are 1,394 active leases in the proposed action area (WPA) that are engaged, or have the potential to be engaged, in drilling and/or production activities that could theoretically result in an accidental spill. Given these existing leases and this ongoing activity, any incomplete information that may lead to reasonable foreseeable significant adverse impacts to sea turtles is not needed to make a reasoned choice among the alternatives, including the No Action alternative.

Coastal and Marine Birds (Chapter 4.1.1.12)

The majority of the effects resulting from routine activities with the WPA proposed action on endangered/nonendangered/and marine birds are expected to be intermittent, of small spatial scale, and short term. The ability to fly will often result in avoidance and quick reestablishment. However, some impacts would be chronic, interfering with the rate of reproduction or the rate of survival. Major impact-producing factors include disturbance by helicopter and service-vessel traffic and associated noise, exposure to or intake of OCS-related contaminants of air and water, displacement of localized groups from degraded habitats, pipeline landfalls and other onshore OCS-related construction, exposure to discarded debris from service vessels and OCS-related structures, and structure presence and associated lighting.

Impacts from pipeline and navigation canals to coastal habitats will occur over the long term and may ultimately displace species. Nocturnal circulation around platforms may create acute sublethal or sometimes sublethal stress from energy loss and increase the risks of collision, while stopovers on platforms would reduce energy loss. Because of regulatory standards for air and water quality (as discussed in **Chapters 4.1.1.1, 4.1.1.2.1, and 4.1.1.2.2**), emissions or produced waters should have a small effect on birds. No significant habitat impacts are expected to occur directly from routine activities resulting from the WPA proposed action because of the distance of most of these activities from shore. Secondary impacts from pipeline and navigation canals to coastal habitats would occur over the long term and could ultimately displace species. These activities would occur whether the proposed action was implemented or not; therefore, the proposed action itself would not increase these secondary impacts to birds.

Although there will always be some level of incomplete information on the effects from routine activities under this proposed action on birds, there is credible scientific information, applied using acceptable scientific methodologies, to support the conclusion that any realized impacts would be generally sublethal in nature and not in themselves rise to the level of reasonably foreseeable significant adverse (population level) effects. Also, routine activities will be ongoing in the proposed action area (WPA) as a result of existing leases and related activities. In the WPA, there are 1,394 active leases. Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that routine activities from the pre-existing OCS program are significantly impacting sea turtle populations. Therefore, a full understanding of any incomplete or unavailable information on the effects of routine activities is not essential to make a reasoned choice among the alternatives.

Oil spills may have serious direct and indirect impacts to coastal and marine bird health and habitat for feeding, roosting, sleeping, and nesting. In shallow water, such spills would have impacts on birds directly through contamination of skin and plumage, interfering with their ability to maintain body temperature, buoyancy, waterproofing, and the ability to fly. Impacts on individuals are much more serious for populations of endangered or threatened species (such as the piping plover and the whooping crane) than for nonlisted species because low populations of listed species may be more likely to face extinction because of the disappearance of a relatively small number of individuals. The lighter PAH's have the greatest impacts on birds because of their persistence and high concentration. They are harmful to cell membranes. The mandatory use of waterbird feeding areas at the sea surface and intertidal wetland zone, where spilled oil tends to accumulate, makes the birds vulnerable to exposure to oil. Exposure to oil in the water column was modeled to be minor. When oil gets into vegetated or unvegetated sediment, it may remain in its unweathered toxic state indefinitely. However, oil weathering as it travels to the coast ameliorates toxicity at the shoreline. Small amounts of oil can affect the health of birds. Birds may have reduced reproductive effort, causing temporary declines in population abundance. Mortality from oil spills is often related to numerous symptoms of toxicity. Data from actual spills strongly suggest that impacts on their food supply are delayed after initial impacts from direct oiling. With properly trained and supervised personnel, impacts of oil-spill cleanup from the proposed action are also expected to be negligible. Although a catastrophic event like the DWH event remains a remote possibility, such a large-scale effort could increase the potential impacts from oil-spill cleanup.

Among accidental events related to the proposed action, oil spills have the greatest potential to impact coastal and marine bird populations. Nevertheless, oil-spill impacts on birds from the WPA proposed action are expected to be negligible because an oil spill would only affect a small portion of a bird group (combined probabilities are always <15%), not rising to the level of populations impacts. An exception would be the piping plover, where impact on a small number of birds could considerably reduce a population. The piping plover is in low abundance but its wintering habitat is plentiful in the Gulf of Mexico. An oil spill would likely only contact a small portion of this wintering habitat in the GOM; thus, the greatest threats to the recovery of the piping plover remain at its breeding habitat in the Great Plains and Great Lakes, not the OCS Program or this proposed action.

Fish Resources and Essential Fish Habitat (Chapter 4.1.1.13)

The BOEMRE has reexamined the analysis for impacts to fish resources and EFH presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented above. No substantial new information was found that would alter the overall conclusion that impacts to fish resources and EFH from routine activities associated with the WPA proposed action would be minimal. Because of the mitigations described in the above analysis, the WPA proposed action is expected to result in a minimal decrease in fish resources and/or standing stocks or in EFH. It would require a short time for fish resources to recover from most of the impacts because impacts to the habitat would generally be temporary, fish tend to avoid areas of impact (thus reducing mortality effects), and most fish species are prolific reproducers. Recovery from the loss of wetlands habitat would probably not occur, but it would likely result in conversion of the lost wetland habitats into open water or mudflats, which may qualify as other forms of EFH.

It is expected that any possible coastal and marine environmental degradation from the WPA proposed action would have little effect on fish resources or EFH. The impact of coastal and marine environmental degradation is expected to cause a nondetectable decrease in fish resources or in EFH. Routine activities such as pipeline trenching and OCS discharge of drilling muds and produced water would cause negligible impacts that would not deleteriously affect fish resources or EFH. This is because of regulations, mitigations, and practices that reduce the undesirable effects on coastal habitats from dredging and other construction activities. Permit requirements should ensure that pipeline routes either avoid different coastal habitat types or that certain techniques are used to decrease impacts. At the expected level of impact, the resultant influence on fish resources would cause minimal changes in fish populations or EFH. That is, if there are impacts, they would be short term and localized; therefore, they would only affect small portions of fish populations and selected areas of EFH. As a result, there would be little disturbance to fish resources or EFH. In deepwater areas, many of the EFH's are protected under stipulations and regulations currently set in place.

Additional hard-substrate habitat provided by structure installation in areas where natural hard bottom is rare would tend to increase fish populations. The removal of these structures would eliminate that habitat, except when decommissioned platforms are used as artificial reef material. This practice is expected to increase over time.

Accidental events that could impact fish resources and EFH include blowouts and oil or chemical spills. Subsurface blowouts, although highly unlikely, have the potential to adversely affect fish resources. If spills due to the WPA proposed action were to occur in open waters of the OCS proximate to mobile adult finfish or shellfish, the effects would likely be nonfatal and the extent of damage would be reduced due to the capability of adult fish and shellfish to avoid a spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds (Chapter 4.4.10 of the Multisale EIS). Fish populations would be primarily affected if the oil reaches the productive shelf and estuarine areas, where fish populations are most concentrated, and this probability is generally low. Also, much of the coastal northern Gulf of Mexico is a moderate- to high-energy environment; therefore, sediment transport and tidal stirring should reduce the chances for oil persisting in these habitats if they are oiled.

The effect of proposed-action-related oil spills on fish resources is expected to cause a minimal decrease in standing stocks of any population because the most common spill events would be small in scale and localized; therefore, they would affect generally only a small potion of fish populations. Historically, there have been no oil spills of any size that have had a long-term impact on fishery populations. Although many potential effects of the DWH event on fish populations of the GOM have been alleged, the actual effects are at this time unknown and the total impacts are likely to be unknown for several years. The BOEMRE has determined that it cannot obtain this information, regardless of cost, within the timeframe of this NEPA analysis, and it may be years before the information is available. In the meantime, as described above, where this incomplete information is relevant to reasonably foreseeable impacts, it was determined if it was essential to a reasoned choice among alternatives and if not, scientifically credible information that is available was used in its stead and applied using accepted methodology.

Commercial Fishing (Chapter 4.1.1.14)

Routine activities such as seismic surveys and pipeline trenching in the WPA would cause negligible impacts and would not deleteriously affect commercial fishing activities. Because seismic surveys are temporary events, they are not expected to cause significant impacts to commercial fisheries. Operations such as production platform emplacement, underwater OCS impediments, and explosive platform removal would cause displacement of commercial fishing while operations are ongoing. These effects are localized to a small percentage of the area fished and they are temporary in nature.

Commercial catches by species and by State have been updated in **Chapter 4.1.14.1**, as have the impacts of the 2005 and 2008 hurricanes on fish and fish habitat from recent reports. The new information presented in this Supplemental EIS does not alter the conclusion presented in the Multisale EIS and the 2007-2009 Supplemental EIS that impacts on commercial fisheries from routine activities associated with the WPA proposed action would be minimal.

The BOEMRE has reexamined the analysis for impacts to commercial fish resources presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on updated information obtained through the peer-reviewed data, Internet sources, and conversations with Gulf Coast State agencies, Federal agencies, and professors at local academic institutions. No significant, newly published, peer-reviewed information was found that would alter the overall conclusion that impacts to commercial fish resources from accidental activities associated with the WPA proposed action would be minimal. In summary, the impacts of the WPA proposed action from accidental events (i.e., a well blowout or an oil spill) are anticipated to be minimal because the potential for oil spills is very low, the most typical events are small and of short duration, and the effects are so localized that fish are typically able to avoid the area adversely impacted.

Fish populations may be impacted by an oil-spill event should it occur, but they would be primarily affected if the oil reaches the productive shelf and estuarine areas because many fish spend a portion of their life cycle there. The probability of an offshore spill impacting these nearshore environments is also low, and oil would generally be volatilized or is dispersed by currents in the offshore environment. The extent of the impacts of the oil would depend on the properties of the oil and the time of year of the event.

Commercial fishermen are anticipated to avoid the area of a well blowout or an oil spill. Fisheries closures may result from a large spill event. These closures may have a negative effect on short-term fisheries catch and/or marketability. In the long term, they may have a positive impact on annually harvested species because there was a decrease in fishing pressure on the stocks.

Recreational Fishing (Chapter 4.1.1.15)

There could be minor and short-term, space-use conflicts with recreational fishermen during the initial phases of the WPA proposed action. The proposed action could also lead to low-level environmental degradation of fish habitat (these are discussed in **Chapter 4.1.1.13.2**), which would negatively impact recreational fishing activity. However, these minor negative effects would likely be outweighed by the beneficial role that oil rigs serve as artificial reefs for fish populations. Each structure placed during the WPA proposed action has the potential to function as a *de facto* artificial reef. The degree to which oil platforms will become a part of a particular State's rigs-to-reefs program will be an important determinant of the degree to which the proposed action would impact recreational fishing activity in the long term.

An oil spill would likely lead to recreational fishing closures in the vicinity of the oil spill. Small-scale spills should not affect recreational fishing to a large degree due to the likely availability of substitute fishing sites in neighboring regions. A rare large spill such as the one associated with the DWH event can have more noticeable effects because of the larger potential closure regions and because of the wider economic implications such closures can have. However, the longer-term implications of a large oil spill would primarily depend on the extent to which fish ecosystems recover after the spill has been cleaned. Because offshore spills have a small probability of contacting estuarine habitats that serve as nurseries for many recreational species and because inshore spills would have localized impacts to an area, oil spills would have a small effect on recreational fisheries.

Recreational Resources (Chapter 4.1.1.16)

Routine OCS actions in the WPA could cause minor disturbances to recreational resources, particularly beaches, through increased levels of noise, debris, and rig visibility. The proposed action would create more platforms to act as artificial reefs; thus, some impacts would be minor or even beneficial through the creation of new fish habitats and diving locations. The OCS activities could also change the composition of local economies through changes in employment, land-use, and recreation demand. Proposed WPA Lease Sale 218 has the potential to directly and indirectly impact recreational resources along the coast of Texas. However, the small scale of the proposed action relative to the scale of the existing oil and gas industry is such that these potential impacts on recreational resources are likely to be minimal.

Spills most likely to result from the WPA proposed action will be small, of short duration, and not likely to impact Gulf Coast recreational resources. Should an oil spill occur and contact a beach area or other recreational resource, it will cause some disruption during the impact and cleanup phases of the spill. However, these effects are also likely to be small in scale and of short duration. This is because the size of a coastal spill is projected to be small (coastal spills are assumed to be 5 bbl; Table 4-13 of the Multisale EIS) and because the probability of an offshore spill contacting most beaches is small. In the unlikely event that a spill occurs that is sufficiently large to affect large areas of the coast and, through public perception, have effects that reach beyond the damaged area, effects to recreation and tourism could be significant. The DWH event was such a case; the resulting spill damaged some coastal resources but had economic effects in a much larger area. The role of perceptions on tourism activity was a particularly important feature of the DWH event, one that should become better understood as the aftermath of the spill unfolds.

Archaeological Resources (Chapter 4.1.1.17)

Historic (Chapter 4.1.1.17.1)

The greatest potential impact to an archaeological resource as a result of the WPA proposed action would result from direct contact between an offshore activity (i.e., platform installation, drilling rig emplacement, and dredging or pipeline project) and a historic site. Archaeological surveys, where required prior to an operator beginning oil and gas activities on a lease, are expected to be effective at identifying possible archaeological sites. The technical requirements of the archaeological resource reports are detailed in NTL 2005-G07, "Archaeological Resource Surveys and Reports." Under 30 CFR

250.194(c) and 30 CFR 250.1010(c), lessees are required to notify this Agency immediately of the discovery of any potential archaeological resources.

Offshore oil and gas activities resulting from the proposed action could impact an archaeological resource because of incomplete knowledge on the location of these sites in the Gulf. The risk of contact to archaeological resources is greater in instances where archaeological survey data are unavailable. Such an event could result in the disturbance or destruction of important archaeological information. Archaeological surveys, where required, would provide the necessary information to develop avoidance strategies that would reduce the potential for impacts on archaeological resources.

Except for the projected 0-1 new gas processing plants and 0-1 new pipeline landfall, the WPA proposed action would require no new oil and gas coastal infrastructure. It is expected that archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities.

Accidental events producing oil spills may threaten archaeological resources along the Gulf Coast. Should a spill contact a historic archaeological site (including submerged sites), damage might include direct impact from oil-spill cleanup equipment and contamination of materials. The major effect from an oil-spill impact would be visual contamination of a historic coastal site, such as a historic fort or lighthouse. Given recent experience, it is expected that any spill cleanup operations would be considered a Federal action for the purposes of Section 106 of the NHPA and would be conducted in such a way as to cause little or no impacts to historic archaeological resources. Recent research suggests the impact of direct contact of oil on historic properties may be long term and not easily reversible without risking damage to fragile historic materials. Previously unrecorded sites could be impacted by oil-spill cleanup operations on beaches and offshore. As indicated in Chapter 4.3.1.8 of the Multisale EIS and in **Table 3-5** of this Supplemental EIS, it is not very likely for an oil spill to occur, and it would not be likely to contact submerged, coastal or barrier island historic sites as a result of the WPA proposed action.

The potential for spills is low, the effects would generally be temporary and localized, and the cleanup efforts would be regulated. The proposed action, therefore, is not expected to result in impacts to historic archaeological sites; however, should such an impact occur, unique or significant archaeological information could be lost, and this impact could be irreversible.

Prehistoric (Chapter 4.1.1.17.2)

The greatest potential impact to an archaeological resource as a result of the WPA proposed action would result from direct contact between an offshore activity (i.e., platform installation, drilling rig emplacement, and dredging or pipeline project) and a prehistoric site. Prehistoric archaeological sites are thought potentially to be preserved shoreward of the 45-m (148-ft) bathymetric contour, where the Gulf of Mexico continental shelf was subaerially exposed during the Late Pleistocene. The archaeological survey and archaeological clearance of sites, where required prior to an operator beginning oil and gas activities on a lease, are expected to be somewhat effective at identifying submerged landforms that could support possible archaeological sites. The NTL 2005-G07 suggests a 300-m (984-ft) line spacing for remote-sensing surveys of leases within areas having a high potential for prehistoric sites. While surveys provide a reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric archaeological site, there is a possibility of an OCS activity contacting an archaeological site because of an insufficiently dense survey grid. Should such contact occur, there would be damage to or loss of significant and/or unique archaeological information.

Accidental events producing oil spills may threaten archaeological resources along the Gulf Coast. Should a spill contact a prehistoric archaeological site, damage might include loss of radiocarbon-dating potential, direct impact from oil-spill cleanup equipment, and/or looting. Previously unrecorded sites could be impacted by oil-spill cleanup operations on beaches. As indicated in Chapter 4.3.1.8 of the Multisale EIS, it is not very likely for an oil spill to occur and contact coastal and barrier island prehistoric sites as a result of the WPA proposed action. The proposed action, therefore, is not expected to result in impacts to prehistoric archaeological sites.

Human Resources and Land Use (Chapter 4.1.1.18)

Land Use and Coastal Infrastructure (Chapter 4.1.1.18.1)

The impacts of routine events associated with proposed WPA Lease Sale 218 are uncertain due to the post-DWH environment, lingering effects of the drilling suspensions, changes in Federal requirements for drilling safety, and current pace of permit approvals. The BOEMRE projects 0-1 new gas processing facilities and 0-1 new pipeline landfalls for a single WPA lease sale. However, based on the most current information available, there is only a very slim chance that either would result from proposed WPA Lease Sale 218, and if a new gas processing facility or pipeline landfall were to result, it would likely occur toward the end of the 40-year analysis period. The likelihood of a new gas processing facility or pipeline landfall is much closer to 0 than to 1. The BOEMRE anticipates that there would be maintenance dredging of navigation channels and an increase in activity at services bases as a result of proposed WPA Lease Sale 218. If drilling activity recovers post-DWH event and increases, there could be new increased demand for a waste disposal services as a result of proposed WPA Lease Sale 218. Because of the current near zero estimates for pipeline landfalls and processing facility construction, the routine activities associated with the WPA proposed action would have little effect on land use.

As a result of the DWH event, it is too early to determine substantial, long-term changes in routine event impacts to land use and infrastructure. The BOEMRE anticipates these changes will become apparent over time. Therefore, BOEMRE recognizes the need to continue monitoring all resources for changes that are applicable for land use and infrastructure. From the information that is currently available, in regard to land use and infrastructure, it does not appear that there would be adverse impacts from routine events associated with proposed WPA Lease Sale 218.

Accidental events associated with the WPA proposed action occur at different levels of severity, based in part on the location and size of event. The typical types of accidental events that could affect land use and coastal infrastructure include oil spills, vessel collisions, and chemical/drilling-fluid spills. These may occur anywhere across the spectrum of severity. Typically, accidental events related to OCS activities are generally smaller in scale based on historic experience, and they must be distinguished from low-probability, high-impact catastrophic events such as DWH. Typically, the impact of small-scale oil spills, vessel collisions, and chemical/drilling fluid spills are not likely to last long enough to adversely affect overall land use or coastal infrastructure in the analysis area.

Many of the impacts of the DWH event to land use and infrastructure have been temporary and short-term, such as the ship decontamination sites and the waste staging areas established in the immediate aftermath of the DWH event. The indirect effects on infrastructure use are still rippling through the industry, but this should resolve as issues with the moratorium, permitting, etc. are resolved. With regards to land use and infrastructure, the post-DWH event environment remains somewhat dynamic, and the BOEMRE will continue to monitor these resources over time and to document short- and long-term DWH event impacts. In the future, the long-term impacts of the DWH event will be clearer as time allows the production of peer-reviewed research and targeted studies that determine those impacts. The DWH event was a low-probability, high-impact catastrophic event. For the reasons set forth in the analysis above, the kinds of accidental events that are likely to result from proposed WPA Lease Sale 218 are not likely to significantly affect land use and coastal infrastructure. This is because accidental events offshore would have a small probability of impacting onshore resources. Also, if an accident occurs near shore, it would be most probably be near a facility; therefore, the impacts would be temporary and localized because of the decrease in response time.

Demographics (Chapter 4.1.1.18.2)

Proposed WPA Lease Sale 218 is projected to minimally affect the demography of the analysis area. Population impacts from the proposed action are projected to be minimal (<1% of the total population) for any economic impact area (EIA) in the Gulf of Mexico region. The baseline population patterns and distributions, as projected and described in **Chapter 4.1.1.18.2.1**, are expected to remain unchanged as a result of proposed WPA Lease Sale 218. The increase in employment is expected to be met primarily with the existing population and available labor force, with the exception of some in-migration projected to occur in focal areas, such as Port Fourchon.

Accidental events may cause short-term population movements, but the events would not be expected to affect demographic characteristics as a whole in the affected area.

Economic Factors (Chapter 4.1.1.18.3)

Should proposed WPA Lease Sale 218 occur, there would be only minor economic changes in the Texas, Louisiana, Mississippi, Alabama, and Florida EIA's. This is because the demand would be met primarily with the existing population and labor force. Proposed WPA Lease Sale 218 is expected to generate less than a 1 percent increase in employment in any of these subareas. Most of the employment related to proposed WPA Lease Sale 218 is expected to occur in Texas (EIA TX-3) and Louisiana (EIA's LA-2, LA-3, and LA-4). The demand would be met primarily with the existing population and labor force for reasons discussed above.

The short-term social and economic consequences for the Gulf coastal region should a spill ≥1,000 bbl occur includes the opportunity cost of employment and expenditures that could have gone to production or consumption rather the spill cleanup efforts. Nonmarket effects such as traffic congestion, strains on public services, shortages of commodities or services, and disruptions to the normal patterns of activities or expectations are also expected to occur in the short term. These negative, short-term social and economic consequences of a spill are expected to be modest in terms of projected cleanup expenditures and the number of people employed in cleanup and remediation activities. Negative, long-term economic and social impacts may be more substantial if fishing, shrimping, oystering, and/or tourism were to suffer or were to be perceived as having suffered because of the spill or if there were substantial changes to the energy industries in the region as a result of the spill. Net employment impacts from a spill are not expected to exceed 1 percent of baseline employment for any EIA in any given year even if they are included with employment associated with routine oil and gas development activities associated with proposed WPA Lease Sale 218.

Environmental Justice (Chapter 4.1.1.18.4)

Because of the existing extensive and widespread support system for OCS-related industry and associated labor force, the effects of proposed WPA Lease Sale 218 are expected to be widely distributed and to have little impact. This is because the proposed action is not expected to significantly change most of the existing conditions, such as traffic or the amount of infrastructure. In general, who would be hired and where new infrastructure might be located is impossible to predict, but, in any case, it would be very limited. Impacts related to the WPA proposed action are expected to be economic and to have a limited but positive effect on low-income and minority populations. Given the existing distribution of the industry and the limited concentrations of minority and low-income peoples, the WPA proposed action is not expected to have a disproportionate effect on these populations within the WPA.

Future changes in activity levels would most likely be caused by fluctuations in oil prices and imports, and not by activities related to the proposed action. The WPA proposed action is not expected to have disproportionate high/adverse environmental or health effects on minority or low-income people.

Chemical and drilling-fluid spills may be associated with exploration, production, or transportation activities that result from the WPA proposed action. Low-income and minority populations might be more sensitive to oil spills in coastal waters than is the general population because of their dietary reliance on wild coastal resources, their reliance on these resources for other subsistence purposes such as sharing and bartering, their limited flexibility in substituting wild resources with purchased ones, and their likelihood of participating in cleanup efforts and other mitigating activities. With the exception of a catastrophic accidental event, such as the DWH event, the impacts of oil spills, vessel collisions, and chemical/drilling fluid spills are not likely to be of sufficient duration to have adverse and disproportionate long-term effects for low-income and minority communities in the analysis area.

An event like the DWH event could have adverse and disproportionate effects for low-income and minority communities in the analysis area. Many of the long-term impacts of the DWH event to low-income and minority communities are unknown. While economic impacts have been partially mitigated by employers retaining employees for delayed maintenance or through the Gulf Coast Claims Facility Program's emergency funds, the physical and mental health effects to both children and adults within these communities could potentially unfold for many years. As studies of past oil spills have highlighted, different cultural groups can possess varying capacities to cope with these types of events. Likewise, some low-income and/or minority groups may be more reliant on natural resources and/or less equipped to substitute contaminated or inaccessible natural resources with private market offerings. Because lower-income and/or minority communities may live near and directly involved with spill cleanup efforts, the vectors of exposure can be higher for them than for the general population, increasing the potential risks of long-term health affects. To date, there have been no longitudinal epidemiological studies of possible long-term health effects for oil-spill cleanup workers. The post-DWH event human environment remains dynamic, and BOEMRE will continue to monitor these populations over time and to document short- and long-term DWH event impacts. In the future, the long-term impacts of the DWH event will be clearer as time allows the production of peer-reviewed research and targeted studies that determine those impacts.

The DWH event was a low-probability, high-impact catastrophic event. For the reasons set forth in the analysis above, the kinds of accidental events (smaller, shorter time scale) that are likely to result from proposed WPA Lease Sale 218 may affect low-income and/or minority more than the general population, at least in the shorter term. These higher risk groups may lack the financial or social resources and may be more sensitive and less equipped to cope with the disruption these events pose. These smaller events, however, are not likely to significantly affect minority and low-income communities in the long term.

Additional Resources Considered due to the *Deepwater Horizon* Event (Chapter 4.1.1.19)

Soft Bottoms (Chapter 4.1.1.19.1)

Although localized impacts to comparatively small areas of the soft-bottom benthic habitats would occur, the impacts would be on a relatively small area of the seafloor compared with the overall area of the seafloor of the WPA (115,645 km^2; 44,651 mi^2). The greatest impact is the alteration of benthic communities as a result of smothering, chemical toxicity, and substrate change. Communities that are smothered by cuttings repopulate, and populations that are eliminated as a result of sediment toxicity or organic enrichment would be taken over by more tolerant species. The community alterations are not so much the introduction of a new benthic community as a shift in species dominance. These localized impacts generally occur within a few hundred meters of platforms, and the greatest impacts are seen close to the platform. These patchy habitats within the Gulf of Mexico are probably not very different from the early successional communities that predominate throughout areas of the Gulf of Mexico that are frequently disturbed.

Because of the small amount of proportional space that OCS activities occupy on the seafloor, only a very small portion of the seafloor of the Gulf of Mexico would experience lethal impacts as a result of blowouts, surface, and subsurface oil spills and the associated affects. The greatest impacts would be closest to the spill, and impacts would decrease with distance from the spill. Contact with spilled oil at a distance from the spill would likely cause sublethal to immeasurable effects to benthic organisms because the distance of activity would prevent contact with concentrated oil. Oil from a subsurface spill that reaches benthic communities would be primarily sublethal, and impacts would be at the local community level. Any sedimentation and sedimented oil would also be at low concentrations by the time it reaches benthic communities far from the location of the spill, also resulting in sublethal impacts. Also, any local communities that are lost would be repopulated fairly rapidly. Although an oil spill may have some detrimental impacts, especially closest to the occurrence of the spill, the impacts may be no greater than natural biological fluctuations, and impacts would be to an extremely small portion of the overall Gulf of Mexico.

Diamondback Terrapins (Chapter 4.1.1.19.2)

Adverse impacts due to routine activities resulting from the WPA proposed action are possible but unlikely. Because of the greatly improved handling of waste and trash by industry, and the annual awareness training required by the marine debris mitigations, the plastics in the ocean are decreasing and the devastating effects on offshore and coastal marine life are minimizing. The routine activities of the WPA proposed action are unlikely to have significant adverse effects on the size and recovery of any terrapin species or population in the GOM. Most routine OCS energy-related activities are expected to have sublethal effects, such as behavioral effects, that are not expected to rise to the level of significance to the populations.

Although there will always be some level of incomplete information on the effects from routine activities under this proposed action on diamondback terrapin, there is credible scientific information, applied using acceptable scientific methodologies, to support the conclusion that any realized impacts would be sublethal in nature and not in themselves rise to the level of reasonably foreseeable significant adverse (population level) effects. Also, routine activities will be ongoing in the proposed action area (WPA) as a result of existing leases and related activities. In the WPA, there are 1,394 active leases. Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that routine activities from the pre-existing OCS program are significantly impacting diamondback terrapin populations. Therefore, a full understanding of any incomplete or unavailable information on the effects of routine activities is not essential to make a reasoned choice among the alternatives.

Impacts on diamondback terrapins from smaller accidental events are likely to affect individual diamondback terrapins in the spill area, as described above, but are unlikely to rise to the level of population effects (or significance) given the probable size and scope of such spills. Further, the potential remains for smaller accidental spills to occur in the proposed action area (WPA), regardless of any alternative selected under this Supplemental EIS, given there are 1,394 active leases already in this area with either ongoing or the potential for exploration, drilling, and production activities.

The analyses within this Supplemental EIS and **Appendix B** conclude that there is a low probability for catastrophic spills, and **Appendix B** concludes that there is a potential for a low probability catastrophic event to result in significant, population-level effects on affected diamondback terrapin species. The BOEMRE continues to concur with the conclusions from these analyses.

The BOEMRE concludes that there is incomplete or unavailable information that may lead to reasonably foreseeable significant adverse impacts to diamondback terrapins from accidental events. For example, there is incomplete information on impacts to diamondback terrapin populations from the DWH event, or that could result from a similar catastrophic spill. Relevant data on the status of and impacts to diamondback terrapin populations from the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeframe contemplated in this Supplemental EIS, regardless of the cost or resources needed. In the absence of this information, BOEMRE subject-matter experts have used what scientifically credible information that is available and applied using accepted scientific methodologies. The BOEMRE does not, however, believe this incomplete information is essential to make a reasoned choice among alternatives primarily because activities that could result in an accidental spill in the WPA would be ongoing whether or not the lease sale under the proposed action of this Supplemental EIS occurred. At present, there are 1,394 active leases in the proposed action area (WPA) that are engaged, or have the potential to be engaged, in drilling and/or production activities that could theoretically result in an accidental spill. Given these existing leases and this ongoing activity, any incomplete information that may lead to reasonable foreseeable significant adverse impacts to diamondback terrapins is not needed to make a reasoned choice among the alternatives, including the No Action alternative.

2.3.1.3. Mitigating Measures

The following four environmental and military mitigations, referred to as lease stipulations, were included for analysis in the Chapter 2.3.1.3 of the Multisale EIS and the 2009-2012 Supplemental EIS. Any stipulations or mitigation requirements to be included in the lease sale will be described in detail in the Final NOS. Stipulations or mitigation requirements in addition to the those analyzed in this Supplemental EIS can also be developed and applied, and will also be described in detail in the Final NOS.

2.3.1.3.1. Topographic Features Stipulation

The Topographic Features Stipulation protects the biota of the topographic features from adverse effects due to routine oil and gas activities, including physical damage from anchoring and rig emplacement and the potential toxic and smothering effects from muds and cuttings discharges. The Topographic Features Stipulation has been included in leases since 1973 and has effectively prevented damage to the biota of these banks from routine oil and gas activities such as anchoring. Monitoring studies have demonstrated that the shunting requirements of the stipulation are effective in preventing the drilling mud and cuttings from impacting the biota of the banks. The topographic highs on and near these blocks are often associated with salt domes, which are attractive areas for hydrocarbon exploration. Instead, blocks on the topographic features have been offered for lease with a stipulation that has proven effective in protecting sensitive biological resources. The location of the blocks affected by the Topographic Features Stipulation is shown on **Figure 2-1**.

2.3.1.3.2. Military Areas Stipulation

The Military Areas Stipulation has been applied to all blocks leased in military areas since 1977 and reduces potential impacts, particularly in regards to safety; but, it does not reduce or eliminate the actual physical presence of oil and gas operations in areas where military operations are conducted. The stipulation contains a "hold harmless" clause (holding the U.S. Government harmless in case of an accident involving military operations) and requires lessees to coordinate their activities with appropriate local military contacts. **Figure 2-3** shows the military warning areas in the Gulf of Mexico.

2.3.1.3.3. Protected Species Stipulation

The Protected Species Stipulation has been applied to all blocks leased in the GOM since December 2001. This stipulation was developed in consultation with the Department of Commerce, NOAA, NMFS, and the Department of the Interior, FWS in accordance with Section 7 of the ESA and is designed to minimize or avoid potential adverse impacts to federally protected species.

2.3.1.3.4. Law of the Sea Convention Royalty Payment Stipulation

The Law of the Sea Convention Royalty Payment Stipulation applies to blocks or portions of blocks beyond the U.S. Exclusive Economic Zone (generally greater than 200 nmi [230 mi; 370 km] from the U.S. coastline). Leases on these blocks may be subject to special royalty payments under the provisions of the 1982 Law of the Sea Convention (consistent with Article 82), if the U.S. becomes a party to the Convention prior to or during the life of the lease.

2.3.2. Alternative B—The Proposed Action Excluding the Unleased Blocks Near the Biologically Sensitive Topographic Features

2.3.2.1. Description

Alternative B differs from Alternative A by not offering the blocks that are possibly affected by the proposed Topographic Features Stipulation (**Chapter 2.3.1.3.1** and **Figure 2-1**). All of the assumptions (including the three other potential mitigating measures) and estimates are the same as for Alternative A. A description of Alternative A is presented in **Chapter 2.3.1.1**.

2.3.2.2. Summary of Impacts

The analyses of impacts summarized in **Chapter 2.3.1.2** and described in detail in **Chapter 4** are based on the development scenario, which is a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. A detailed discussion of the development scenario and major related impact-producing factors is included in **Chapter 3**.

The difference between the potential impacts described for Alternative A and those under Alternative B is that under Alternative B no oil and gas activity would take place in the blocks subject to the Topographic Features Stipulation (**Figure 2-1**). The number of blocks that would not be offered under Alternative B represents only a small percentage of the total number of blocks to be offered under Alternative A; therefore, it is assumed that the levels of activity for Alternative B would be essentially the same as those projected for the proposed action. As a result, the impacts expected to result from Alternative B would be very similar to those described under the proposed action (**Chapter 4**). Therefore, the regional impact levels for all resources, except for the topographic features, would be similar to those described under the proposed action. This alternative, if adopted, would prevent any oil and gas activity whatsoever in the affected blocks; thus, it would eliminate any potential direct impacts to the biota of those blocks from oil and gas activities, which otherwise would be conducted within the blocks.

2.3.3. Alternative C—No Action

2.3.3.1. Description

Alternative C is the cancellation of the proposed WPA lease sale. The opportunity for development of the estimated 0.222-0.423 BBO and 1.495-2.647 Tcf of gas that could have resulted from the proposed lease sale would be precluded or postponed. Any potential environmental impacts resulting from the proposed lease sale would not occur or would be postponed.

2.3.3.2. Summary of Impacts

Canceling the lease sale would eliminate the effects described for Alternative A (**Chapter 4.1**). The incremental contribution of the proposed lease sale to cumulative effects would also be foregone, but effects from other activities, including other OCS lease sales, would remain.

If the lease sale would be canceled, the resulting development of oil and gas would most likely be postponed to a future sale; therefore, the overall level of OCS activity in the WPA would only be reduced by a small percentage, if any. Therefore, the cancellation of the proposed lease sale would not significantly change the environmental impacts of overall OCS activity. However, the cancellation of the lease sale may result in direct economic impacts to the individual companies. Revenues collected by the Federal Government (and thus revenue disbursements to the States) would be adversely affected also.

Other sources of energy may substitute for the lost production. Principal substitutes would be additional imports, conservation, additional domestic production, and switching to other fuels. These alternatives, except conservation, have significant negative environmental impacts of their own.

CHAPTER 3

IMPACT-PRODUCING FACTORS AND SCENARIO

3. IMPACT-PRODUCING FACTORS AND SCENARIO

In order to describe the level of activity that could reasonably result from the proposed action (i.e., proposed lease sale), BOEMRE developed exploration and development activity scenarios. These scenarios provide a framework for analyses of potential environmental and socioeconomic impacts of the proposed lease sale that could potentially affect the biological, physical, and socioeconomic resources of the Gulf of Mexico. The offshore and coastal impact-producing factors and scenario can be found in Chapters 4.1.1 and 4.1.2 of the Multisale EIS, respectively, and in Chapters 3.1.1 and 3.1.2 of the 2009-2012 Supplemental EIS, respectively. The following is a summary of offshore and coastal impact-producing factors with activity scenarios from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The potential impacts of the offshore and coastal activities associated with proposed WPA Lease Sale 218 are considered in the environmental analysis sections in **Chapter 4**.

3.1. IMPACT-PRODUCING FACTORS AND SCENARIO—ROUTINE OPERATIONS

3.1.1. Offshore Impact-Producing Factors and Scenario

Chapter 4.1.1 of the Multisale EIS and Chapter 3.1.1 of the 2009-2012 Supplemental EIS describe the infrastructure and activities (impact-producing factors) that would occur offshore as a result of a proposed action. Those discussions are incorporated by reference.

The WPA sale area encompasses about 28.7 million acres (ac) mostly located beyond 3 leagues (10 miles [mi]; 16 kilometers [km]) offshore Texas and extends seaward to the limits of the United States jurisdiction over the continental shelf in water depths up to approximately 3,346 meters (m) (10,978 feet [ft]) (**Figure 1-1**).”

The projections used to develop the offshore proposed action scenarios are based on resource estimates as summarized in the *Planning Area Resources Addendum to Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation’s Outer Continental Shelf, 2006* (USDOI, MMS, 2006a), current industry information, and historical trends.

The proposed action scenarios are based on the following factors:

- recent trends in the amount and location of leasing, exploration, and development activity;
- estimates of undiscovered, unleased, conventionally recoverable oil and gas resources in the planning area;
- existing offshore and onshore oil and/or gas infrastructure;
- industry information; and
- oil and gas technologies, and the economic considerations and environmental constraints of these technologies.

In order to present the best reasonable projections possible, BOEMRE continually updates models and formulas used to develop these scenarios. The experience of subject matter experts is incorporated into this process, along with the latest industry trends and historical data.

The proposed lease sale is represented by bounded ranges for resource estimates, projected exploration and development activities, and impact-producing factors. The proposed lease sale is expected to be within the scenario ranges. The scenarios used in this Supplemental EIS represent the best assumptions and estimates of a set of future conditions that are considered reasonably foreseeable after the DWH event and suitable for presale impact analyses. These scenarios do not represent a BOEMRE recommendation, preference, or endorsement of any level of leasing or offshore operations, or of the types, numbers, and/or locations of any onshore operations or facilities.

Analysis Period

The BOEMRE assumes fields discovered as a result of a proposed action will reach the end of their economic life within 40 years of the lease sale. Activity levels are not projected beyond 40 years. This is based on averages for time required for exploration, development, production life, and decommissioning for leases in the GOM.

Deepwater Horizon Event

This Supplemental EIS was prepared because of the potential changes to the baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the DWH event between April 20 and July 15, 2010 (the period when oil flowed from the Macondo well in Mississippi Canyon Block 252 [**Figure 1-2**]); (2) the acute impacts that have been reported or surveyed since that time; and (3) any new information that may be available since the Multisale EIS or 2009-2012 Supplemental EIS. The environmental resources analyzed include sensitive coastal environments, offshore benthic resources, marine mammals, sea turtles, coastal and marine birds, endangered and threatened species, and fisheries. This Supplemental EIS analyzes the potential impacts of the proposed action on the marine, coastal, and human environments. It is important to note that this Supplemental EIS was prepared using the best information that was publicly available at the time this document was prepared.

The BOEMRE, Gulf of Mexico OCS Region, Resource and Evaluation Office's Modeling and Forecasting Team has reevaluated the exploration and development activity scenario for a WPA proposed action because of the DWH event and the cancellation of WPA Lease Sale 215.

Resource Estimate and Timetables

The resource estimates for a proposed action are based on two factors: (1) the conditional estimates of undiscovered, unleased, conventionally recoverable oil and gas resources in the proposed lease sale areas; and (2) the estimates of the portion or percentage of these resources assumed to be leased, discovered, developed, and produced as a result of a proposed action. The estimates of undiscovered, unleased, conventionally recoverable oil and gas resources are based upon a comprehensive appraisal of the conventionally recoverable petroleum resources of the Nation as of January 1, 2003. Because of the inherent uncertainties associated with an assessment of undiscovered resources, techniques were employed and the results were reported as a range of values corresponding to different probabilities of occurrence.

A summarized discussion of the methodologies employed and the results obtained in the assessment are presented in this Agency's brochure entitled, *Planning Area Resources Addendum to Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation's Outer Continental Shelf, 2006* (USDOI, MMS, 2006a). The estimates of the portion of the resources projected to be leased, discovered, developed, and produced as a result of a proposed action are based upon logical sequences of events that incorporate past experience, current conditions, and foreseeable development strategies. A wealth of historical databases and information derived from oil and gas exploration and development activities are available to BOEMRE and were used extensively. The undiscovered, unleased, conventionally recoverable resource estimates for a proposed action are expressed as ranges, from low to high. This range provides a reasonable expectation of oil and gas production anticipated from typical lease sales held as a result of the proposed actions based on an actual range of historic observations.

Table 3-1 presents the projected ranges for oil and gas production resulting from the proposed WPA lease sale. Major impact-producing factors, including the number of exploration and delineation wells, production platforms, and development wells projected to develop and produce the estimated resources for the WPA proposed action, are given in **Table 3-2**. **Table 3-2** shows the distribution of these factors by offshore subareas in the proposed lease sale area. The proposed lease sale area was divided into offshore subareas based upon water-depth range (**Figure 3-1**) that reflect the technological requirements and related physical and economic impacts.

For purposes of analysis, the life of the leases resulting from the proposed action is assumed to not exceed 40 years because, historically, the entire life of a well from beginning to end is encompassed within a 40-year period. Following the proposed action (lease sale), areawide exploratory drilling activity would take place over an 8-year period, beginning within 1 year after the lease sale. Final decommissioning and removal activities occur from the 15th year to the 40th year.

Activity as the result of a lease sale is assumed to be staggered over time. A recently published Agency study estimated physical and economic performance measures to characterize lease sales and development in the GOM (Iledare and Kaiser, 2007). It was used to further refine the scenario presented in the Multisale EIS. The average lag of exploration and production from leases issued from 1983 to 1999 increased by water depth and decreased over time as shown in the Tables 3-4 and 3-5 in the 2009-2012 Supplemental EIS. Because of variation by water depth, exploration and production activity is staggered over time, taking on average 1.9-4.5 years after a lease sale before exploration begins and 3.4-8.3 years before first production.

3.1.1.1. Exploration and Delineation

Chapter 4.1.1.2.2 of the Multisale EIS and Chapter 3.1.1.1 of the 2009-2012 Supplemental EIS describe the impacting factors arising from exploration and delineation drilling in the GOM resulting from a proposed action in the WPA. The discussion in this Supplemental EIS tiers from the discussion in the Multisale EIS and the 2009-2012 Supplemental EIS.

3.1.1.1.1. Seismic Surveying Operations

Prelease surveys are comprised of seismic work performed on or off leased areas, focused most commonly (but not always) on deeper targets and collectively authorized under BOEMRE's geological and geophysical permitting process. Postlease, high-resolution seismic surveys collect data on surficial geology used to identify potential shallow geologic hazards for engineering and site planning for bottom-founded structures. They are also used to identify environmental resources such as chemosynthetic community habitat, gas hydrates, buried channels and faults, and archaeological resources. High-resolution surveys are conducted as authorized under the terms and conditions of the lease agreement. Other postlease surveys include downhole seismic surveying (vertical seismic profiling [VSP]) and time-lapse, deep-focused, 3D surveying (4D surveys) used for reservoir monitoring.

All seismic surveying constitutes a type of remote sensing. Typical prelease seismic surveying operations for exploring deep geologic formations typically are two or three dimensional (2D or 3D). A tow vessel pulls an array of airguns and streamers (acoustic receiver cable) behind the vessel 5-10 m (16-33 ft) below the sea surface. Ocean-bottom systems may be deployed instead of streamers in shallow water, areas of dense infrastructure, or when 4D seismic is used to aid in reservoir management,. This methodology utilizes hydrophones placed statically on the seafloor. The energy source (airgun arrays) remains the same as streamer methods and is towed behind a source vessel. The airgun array produces a burst of underwater sound by releasing compressed air into the water column, creating an acoustical energy pulse the echoes of which are detected by hydrophones towed on streamers behind the vessel. Streamer arrays are 3-8 mi (5-12 km) or greater in length, depending on survey specifications. Tow vessel speed is typically 3-5 knots (kn) (about 4-6 miles per hour [mph]) with gear deployed.

The 3D surveys carried out by seismic vendors can consist of a few to several hundred OCS blocks. Multiple source and multiple-streamer technologies are often used for 3D seismic surveys. For a typical 3D survey, air in a closed chamber of the air gun is quickly discharged through a port, creating a pressure pulse and air bubble in the water. To release more energy into the pressure pulse and to offset the deleterious effects of bubble oscillations on the pressure pulse, multiple airguns with various chamber sizes are used. These individual airgun chamber sizes vary from 20 to 380 in^3 (327 to 6,227 cm^3). In some cases, two or three airguns are placed in a cluster to increase the effective chamber size. The individual airguns are suspended in the water from a float system referred to as a sub-array. Each sub-array contains six or seven individual airguns spaced from 2.5 to 3 m (7.5 to 10 ft) apart, making the total sub-array length 14-17 m (46-56 ft) long. Typically, three (sometimes four) sub-arrays are combined to form an array. When three sub-array elements are used, the spacing is 8 m (26 ft) between sub-arrays; when four sub-arrays are used, the spacing is 12 m (39 ft). Thus, the overall width of the array is generally 16-36 m (52-118 ft). The array is towed at a depth of 5-7 m (16-23 ft).

A four-dimensional or time-lapse survey is used to monitor how a reservoir drains to optimize the amount of hydrocarbon recovered. These surveys consist of a series of 3D surveys collected over time under the same acquisition and receiving parameters.

Vertical seismic profiling (VSP) is usually done by placing a receiver down a wellbore at different depths and with an external acoustic source near the wellbore (zero-offset VSP) or on a vessel at different distances from the wellbore (called a walk-away VSP). These surveys are used to obtain information about the nature of the seismic signal, as well as more information about the geology surrounding the vertical array of sensors. The VSP data can be cross-correlated with ship-towed seismic survey datasets to refine identification of lithologic changes and the content of formation fluids. Zero offset and walk-away VSP surveys are by far and away the most common VSP surveys conducted in the GOM.

Ocean-Bottom Surveys

Ocean-bottom cable surveys were originally designed to enable seismic surveys in congested areas, such as producing fields, with their many platforms and producing facilities. Autonomous nodes, deployed and retrieved by either cable or ROV's, are now used as an alternative to cables. The ocean-bottom cable surveys have been found to be useful for obtaining multicomponent (i.e., seismic pressure, vertical, and the two horizontal motions of the water bottom, or seafloor) information.

The ocean-bottom cable surveys and nodal acquisition require the use of multiple ships (i.e., usually two ships for cable or node layout/pickup, one ship for recording, one ship for shooting, and two utility boats). These ships are generally smaller than those used in streamer operations, and the utility boats can be very small. Operations are conducted "around the clock" and begin by dropping the cables off the back of the layout boat or by deployment of the nodal receivers by ROV's. Cable length or the numbers of nodes depend upon the survey demands; it is typically 2.6 mi (4.2 km) but can be up to 7.5 mi (12 km). However, depending on spacing and survey size, hundreds of nodes can be deployed and re-deployed over the span of the survey. Groups of seismic detectors, usually hydrophones and vertical motion geophones, are attached to the cable in intervals of 82-164 ft (25-50 m), or autonomous nodes are spaced similarly. Multiple cables/nodes are laid parallel to each other using this layout method, with a 164-ft (50-m) interval between cables/nodes. Typically, dual airgun arrays are used on a single source vessel. When the cable/node is in place, a ship towing an airgun array (which is the same airgun array used for streamer work) passes between the cables/nodes, firing every 82 ft (25 m). Sometimes a faster source ship speed of 7 mph (6 kn), instead of the normal speed of 5.2 mph (4.5 kn), is used with a decrease in time between gun firings. After a source line is shot, the source ship takes about 10-15 minutes to turn around and pass down between the next two cables or line of nodes. When a cable/node is no longer needed to record seismic data, it is picked up by the cable pickup ship and is moved over to the next position where it is needed. The nodes are retrieved by an ROV. A particular cable/node can lay on the bottom anywhere from 2 hours to several days, depending on operation conditions. Normally, a cable will be left in place about 24 hours. However, nodes may remain in place until the survey is completed or recovered and then re-deployed by an ROV.

Location of the cables/nodes on the bottom is done by acoustic pingers located at the detector groups and by using the time of first arrival of the seismic pulse at the detector group. A detector group is a node or group of nodes that enable the seismic ship to accurately determine node location. To obtain more accurate first arrival times, the seismic data are recorded with less electronic filtering than is normally used. This detailed location is combined with normal global positioning system (GPS) navigational data collected on the source ship. In deep water, the process of accurately locating bottom cables/nodes is more difficult because of the effects of irregular water bottoms and the thermal layers, which affect travel times and travel paths, thus causing positioning errors.

As part of the environmental impact analysis required with the EP, DOCD, or DPP, 30 CFR 250.227(b)(6) and 30 CFR 250.261(b)(6) require the applicant to submit archaeological information. In certain circumstances, the BOEMRE Regional Director may require the preparation of an archaeological report to accompany the EP, DOCD, or DPP under 30 CFR 250.194. The requirements for archaeological reports are clarified in NTL 2005-G07, "Archaeological Resource Surveys and Reports." If the archaeological report, where required, indicates that an archaeological resource may be present, the lessee must either locate the site of any operation so as not to adversely affect the area where the archaeological resource may be, demonstrate that an archaeological resource does not exist, or demonstrate that archaeological resources will not be adversely affected by operations. If the lessee discovers any archaeological resource while conducting approved operations, operations must be immediately stopped and the discovery reported to the BOEMRE Regional Supervisor, Office of Leasing and Environment, within 48 hours of its discovery.

WPA Proposed Action Scenario: Because of the cyclic nature of seismic surveys, a prelease seismic survey would be attributable to lease sales held up to 7-9 years after the survey. Based on an amalgam of historical trends in G&G permitting and industry input for the Gulf of Mexico G&G Programmatic EIS, BOEMRE projects that the WPA proposed action would result in 400-800 OCS blocks surveyed by deep seismic operations. For postlease seismic surveys, information obtained from high-resolution seismic contractors operating in the Gulf of Mexico project the WPA proposed action would result in about 20 VSP operations and about 2,000 line miles (3,220 km) of near-surface and shallow penetration seismic during the life of the proposed action.

OCS Program Scenario: Seismic surveys are projected to follow the same trend as exploration activities, which peaked in 2008-2010, steadily decline until 2027, and remain relatively steady throughout the second half of the 40-year analysis period. During the first 2-4 years of the analysis period, BOEMRE projects annually there would be 50-60 VSP operations, 12,500-16,500 lines miles (20,117-24.945 km) surveyed by high-resolution seismic, and 1,500-3,000 blocks surveyed by deep seismic. During the second half of the analysis period, it is projected annually there would be 60-70 VSP operations, 6,200-8,300 mi (9,978-13,356 km) surveyed by high-resolution seismic, and 1,200-2,500 blocks surveyed by deep seismic.

3.1.1.1.2. Exploration and Delineation Drilling

Oil and gas operators use drilling terms that represent stages in the discovery and exploitation of hydrocarbon resources. An exploration well generally refers to the first well drilled on a prospective geologic structure to confirm that a resource exists and to validate how much resource can be expected. If a resource is discovered in quantities appearing to be economically viable, one or more follow-up delineation wells help define the amount of resource or the extent of the reservoir. Following a discovery, an operator will often temporarily plug and abandon a discovery to allow time for a development scenario to be generated and for equipment to be built or procured.

In the GOM, exploration and delineation wells are typically drilled with MODU's; e.g., jack-up rigs, semisubmersible rigs, submersible, platform rigs, or drill ships. Non-MODU drilling units, such as inland barges, are also used. The type of rig chosen to drill a prospect depends primarily on water depth. Because the water-depth ranges for each type of drilling rig overlap to a degree, other factors such as availability and daily rates play a large role when an operator decides upon the type of rig to contract. The depth ranges for exploration rigs used in this analysis for Gulf of Mexico MODU's are indicated below.

MODU or Drilling Rig Type	Water Depth Range
Jack-up, submersible, and inland barges	≤100 m
Semisubmersible and platform rig	100-3,000 m
Drillship	≥600 m

Table 3-3 shows GOM deepwater rig counts and average day rates for contracting the typical rig types used for OCS exploration, although some operators have discounted prices for multiyear contracts. The scenarios for the proposed actions presented in the Multisale EIS assumed that an average exploration/delineation well will require 30-45 days to drill. The actual time required for each well depends on a variety of factors, including the depth below mudline of the prospect's potential target zone, the complexity of the well design, and the directional offset of the wellbore needed to reach a particular zone.

The cost of an ultra-deepwater well (>6,000 ft; >1,829 m water depth) can be $30-$50 million or more, without certainty that objectives can be reached or if the objective ultimately produces hydrocarbon. Some recent ultra-deepwater exploration wells in the GOM have been reported to have cost upwards of $100 million. The BOEMRE regulations require that operators conduct their offshore operations in a safe manner. Subpart D of BOEMRE's regulations (30 CFR 250) specifies requirements for drilling activities. See **Chapter 1.3.1** and **Table 1-1**, which provide a summary of new safety requirements.

Exploration Plans

The regulation at 30 CFR 250 Subpart B specifies the requirements for the exploration plans (EP's) that operators must submit to BOEMRE for approval prior to deploying an exploration program. An EP must be submitted to BOEMRE for review and decision before any exploration activities, except for preliminary activities, can begin on a lease. The EP describes exploration activities, drilling rig or vessel, proposed drilling and well-testing operations, environmental monitoring plans, oil-spill response plans, and other relevant information, and it includes a proposed schedule of the exploration activities. Guidelines and environmental information requirements for lessees and operators submitting an EP are addressed in 30 CFR 250.211 and are further explained in NTL 2010-N06, "Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS," and in NTL 2009-G27, "Submitting Exploration Plans and Development Operations Coordination Documents." The requirements for shallow hazard surveys and their reports are clarified in NTL 2008-G05, "Shallow Hazards Program."

As part of the environment impact analysis required with EP, DOCD, or DPP, 30 CFR 250.227(b)(6) and 30 CFR 250.261(b)(6) require the applicant to submit archaeological information. In certain circumstances, the BOEMRE Regional Director may require the preparation of an archaeological report to accompany the EP, DOCD, or DPP, under 30 CFR 250.194. The requirements for archaeological reports are clarified in NTL 2005-G07, "Archaeological Resource Surveys and Reports." If the archaeological report, where required, indicates that an archaeological resource may be present, the lessee must either locate the site of any operation so as not to adversely affect the area where the archaeological resource may be, demonstrate that an archaeological resource does not exist, or demonstrate that archaeological resources will not be adversely affected by operations. If the lessee discovers any archaeological resource while conducting approved operations, operations must be immediately stopped and the discovery reported to the BOEMRE Regional Supervisor, Office of Leasing and Environment, within 48 hours of its discovery.

Historically, drilling rig availability has been a limiting factor for activity in the Gulf and is assumed to be a limiting factor for activity projected as a result of the proposed lease sale. A search on the Rigzone website in December 2010 (Rigzone, 2010) showed that operators in the GOM currently had commitments for the following rig classes: 83 jack-ups; 25 semisubmersibles; 6 submersibles; 60 inland barges; and 10 drillships. Operators had a rig utilization rate of about 68 percent, which means that approximately 68 percent of the rigs in the GOM available for contract are contracted and operating. The Rigzone website indicates the total worldwide deployment capability for the various rig classes is 523 jack-ups, 222 semisubmersibles, 6 submersibles, 76 inland barges, and 91 drillships.

Table 3-2 shows the estimated range of exploration and delineation wells by water depth subarea for the WPA proposed action, respectively.

WPA Proposed Action Scenario: The BOEMRE estimates that 40-66 exploration and delineation wells would be drilled as a result of the WPA proposed action. **Table 3-2** shows the estimated range of exploration and delineation wells by water-depth range. Approximately 65 percent of the projected wells are expected to be on the continental shelf (0-200 m [0-656 ft] water depth) and 35 percent are expected in the intermediate water-depth ranges and deeper (>200 m; 656 ft).

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS. The BOEMRE estimates that 2,325-2,864 exploration and delineation wells would be drilled in the WPA as a result of the OCS Program. Tables 4-4, 4-5, and 4-6 of the Multisale EIS show the estimated range of exploration and delineation wells by water-depth range. Of these wells, 69-71 percent are expected to be on the continental shelf (0-200 m [0-656 ft] water depth) and 29-31 percent are expected in intermediate water-depth ranges and deeper (>200 m; 656 ft).

3.1.1.2. Development and Production

Chapter 4.1.1.3 of the Multisale EIS and Chapter 3.1.1.2 of the 2009-2012 Supplemental EIS describe impacting factors arising from development and production drilling activity in the GOM. The discussion in this Supplemental EIS tiers from the discussion in the Multisale EIS and the 2009-2012 Supplemental EIS.

3.1.1.2.1. Development and Production Drilling

Delineation and production wells are sometimes collectively termed development wells. Development wells may be drilled from movable structures, such as jack-up rigs, fixed bottom-supported structures, floating vertically-moored structures, floating production facilities, and drillships (either anchored or dynamically positioned drilling vessels). The type of production structure installed at a site depends mainly on water depth, but the total facility lifecycle, the type and quantity of hydrocarbon production expected, the number of wells to be drilled and produced, and the number of anticipated tie backs from other fields can also influence an operator's development facility procurement decision. The number of wells per structure varies according to the type of production structure used, the prospect size, and the drilling/production strategy deployed for the drilling program and for resource conservation. Production systems can be fixed, floating, or subsea, which has shown an increasing trend in deep water.

This Agency has described and characterized production structures in its deepwater reference document (Regg et al., 2000) and descriptions are summarized in Chapter 3.3.5.7.1 of the Multisale EIS and in Chapter 3.1.1.2.2.1 of the 2009-2012 Supplemental EIS. In water depths up to 400 m (1,312 ft), the scenarios assume that conventional, fixed platforms that are rigidly attached to the seafloor will be the type of structure preferred by operators. In water depths of <200 m (656 ft), 20 percent of the platforms are expected to be manned (defined as having sleeping quarters on the structure). In depths between 200 and 400 m (656 and 1,312 ft), all structures are assumed to be manned. It is also assumed that helipads will be located on 66 percent of the structures in water depths <60 m (197 ft), on 94 percent of the structures in water depths between 60 and 200 m (656 ft), and on 100 percent of the structures in water depths >200 m (656 ft). At water depths >400 m (1,312 ft), platform designs based on rigid attachment to the seafloor are not expected to be used. The 400-m (1,312-ft) isobath appears to be the current economic limit for this type of structure.

Deepwater Operations Plans

A Deepwater Operations Plan (DWOP) is required for all deepwater development projects in water depths ≥1,000 ft (305 m) and for all projects proposing subsea production technology. A DWOP is designed to address industry and BOEMRE concerns by allowing an operator to know, well in advance of significant spending, that their proposed methods of dealing with situations not specifically addressed in the regulations are acceptable to BOEMRE. The DWOP provides BOEMRE with information specific to deepwater/subsea equipment issues to demonstrate that a deepwater project is being developed in an acceptable manner with regard to engineering specifics, safety, and the environment. The BOEMRE will review deepwater development activities from a total system perspective, emphasizing the operational safety, environmental protection, and conservation of natural resources. A DWOP is required initially and is usually followed by a DOCD.

Development Operations and Coordination Document

The chief planning document that lays out an operator's specific intentions for development is the DOCD. The range of postlease development plans is discussed in **Chapter 1.5**. **Table 3-2** shows the estimated range of development wells and production structures by water depth subarea for the WPA proposed action. The BOEMRE estimates that 87-89 percent of development wells would become producing wells.

WPA Proposed Action Scenario: The BOEMRE estimates that 137-221 development wells will be drilled as a result of the WPA proposed action. **Table 3-2** shows the estimated range of development wells by water-depth range. Approximately 47-50 percent of the projected wells are expected to be on the continental shelf (0-200 m [656 ft] water depth) and 50-53 percent are expected in intermediate water-depth ranges and deeper (>200 m; 656 ft). Trends between the oil and gas development wells are markedly different. For oil development wells (39-65), the water-depth range of 800-1,600 m (2,625-5,250 ft) has the largest portion of projected wells, about 59-60 percent. For gas development wells (83-127), the continental shelf (0-60 m [0-200 ft] water depth) has the largest portion of projected wells, about 57-58 percent.

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS. The BOEMRE estimates that 8,160-9,662 development wells will be drilled in the WPA as a result of the OCS Program. Tables 4-4, 4-5, and 4-6 in the Multisale EIS show the estimated range of development wells by water-depth range.

3.1.1.2.2. Infrastructure Presence

Chapter 4.1.1.3.3 of the Multisale EIS and Chapter 3.1.1.2.2 of the 2009-2012 Supplemental EIS describe the impacting factors arising from the presence of OCS facilities in the GOM as a result of a proposed action. These impacting factors include (1) anchoring, (2) offshore production systems, (3) space-use requirements, (4) aesthetic quality, and (5) trash and debris.

3.1.1.2.2.1. Anchoring

Chapter 4.1.1.3.1.1 of the Multisale EIS discusses the impacting factors arising from anchoring in the GOM as a result of the proposed action. Most exploration drilling, platform, and pipeline emplacement operations on the OCS require anchors to hold the rig, topside structures, or support vessels in place. Anchors disturb the seafloor and sediments in the area where dropped or emplaced. Anchoring can cause physical compaction beneath the anchor and chains or lines, as well as resuspended sediment. A disturbed area on the sea bottom forms by the swing arc formed by anchor lines scraping across bottom within the range allowed by the anchoring system configuration. Dynamically positioned rigs, production structures, and vessels are held in position by four or more propeller jets and do not cause anchoring impacts. Conventional pipelaying barges use an array of eight 9,000-kg (19,842-lb) anchors to position the barge and to move it forward along the pipeline route. These anchors are continually moved as the pipelaying operation proceeds. The area actually affected by these anchors depends on water depth, wind, currents, chain length, and the size of the anchor and chain. Mooring buoys may be placed near drilling rigs or platforms so that service vessels need not anchor, or cannot anchor (in deeper water). These temporarily installed anchors will most likely be smaller and lighter than those used for vessel anchoring and, thus, will have less impact on the sea bottom. Moreover, installing one buoy will preclude the need for numerous individual vessel-anchoring occasions. Service vessel anchoring is assumed not to occur in water depths >150 m (492 ft) and only occasionally in shallower waters (vessels would always tie up to a platform or buoy in water depths >150 m [492 ft]). Barges are assumed to always tie up to a production system rather than anchor. Barges and other vessels are also used for both installing and removing structures. Barge vessels use anchors placed away from their location of work.

3.1.1.2.2.2. Offshore Production Systems

Chapters 3.3.5.7.1 and 4.1.1.3.3 of the Multisale EIS and Chapter 3.1.1.2.2.1 of the 2009-2012 Supplemental EIS discuss the impacting factors arising from offshore production systems in the GOM as a result of a proposed action. **Table 3-2** shows the estimated number of production structures by water-depth range for the WPA proposed action.

Spar

A spar structure is a deep-draft, floating caisson that may consist of a large-diameter (27.4-36.6 m; 90-120 ft) cylinder or a cylinder with a lower tubular steel trellis-type component (truss spar, a second generation design) that supports a conventional production deck. A third generation of spar design is the cell spar. The cell spar's hull is composed of several identically sized cylinders surrounding a center cylinder. The cylinder or hull may be moored via a chain catenary or semi-taut line system connected to 6-20 anchors on the seafloor. Spars are now used in water depths up to 900 m (2,952 ft) and may be used in water depths 3,000 m (9,842 ft) or deeper (NaturalGas.org, 2010a; USDOI, MMS, 2006b; Oynes, 2006).

Semisubmersibles

Semisubmersible production structures (semisubmersibles) resemble their drilling rig counterparts and are the most common type of offshore drilling rig (NaturalGas.org, 2010a). Semisubmersibles are partially submerged with pontoons that provide buoyancy. Their hull contains pontoons below the waterline and vertical columns that connect to the hull box/deck. The structures keep on station with conventional, catenary or semi-taut, line mooring systems connected to anchors in the seabed. Semisubmersibles can be operated in a wide range of water depths. Floating production systems are suited for deepwater production in depths up to 8,000 ft (2,438 m) (NaturalGas.org, 2010a; USDOI, MMS, 2006b; Oynes, 2006).

Subsea Production Systems

For some development programs, especially those in deep- and ultra-deepwater, an operator may choose to use a subsea production system instead of a floating production structure. Although the use of subsea systems has recently increased as development has moved into deeper water, subsea systems are not new to the GOM and they are not used exclusively for deepwater development. Unlike wells from conventional fixed structures, subsea wells do not have surface facilities directly supporting them during their production phases. A subsea production system has various bottom-founded components. Among them are well templates, well heads, "jumper" connections between well heads, flow control manifolds, in-field pipelines and their termination sleds, and umbilicals and their termination assemblies. A subsea production system can range from a single-well template connected to a nearby manifold or pipeline, and then to a riser system at a distant production facility; or a series of wells that are tied into the system. Subsea systems rely on a "host" facility for support and well control. Centralized or "host" production facilities in deep water or on the shelf may support several satellite subsea developments. A drilling rig must be brought on location to provide surface support to reenter a well for workovers and other types of well maintenance activities. In addition, should the production/safety system fail and a blowout result, surface support must be brought on location to regain control of the well.

Floating Production, Storage, and Offloading Systems

This Agency prepared an EIS on the potential use of floating production, storage, and offloading (FPSO) systems on the Gulf of Mexico OCS (USDOI, MMS, 2001a). In accordance with the scenario provided by industry, the FPSO EIS addresses the proposed use of FPSO's in the deepwater areas of the CPA and WPA only. In January 2002, this Agency announced its decision to accept applications for FPSO's after a rigorous environmental and safety review. On June 12, 2007, this Agency received a DOCD from Petrobras Americas Inc. proposing to use an FPSO in Walker Ridge to develop two different CPA prospects: Cascade and Chinook. This is the first and only proposal, at this time, to use an FPSO in the GOM. The Cascade Prospect (Walker Ridge Block 206 Unit) is located approximately 250 mi (402 km) south of New Orleans, Louisiana, and about 150 mi (241 km) from the Louisiana coastline in approximately 8,200 ft (2,499 m) of water. The Chinook Prospect (Walker Ridge Block 425 Unit) is located about 16 mi (26 km) south of the Cascade Prospect. The FPSO was approved in March 2011.

3.1.1.2.2.3. Space-Use Requirements

Chapter 4.1.1.3.3.2 of the Multisale EIS and Chapter 3.1.1.2.2.2 of the 2009-2012 Supplemental EIS discuss impacting factors arising from space requirements in the GOM as a result of a WPA proposed action. Leasing on the OCS results in operations that temporarily occupy sea bottom and water surface area for dedicated uses. The OCS operations include the deployment of seismic vessels, bottom surveys, and the installation of surface or subsurface bottom-founded production structures with anchor cables and safety zones. While in use, these areas become unavailable to commercial fishermen or any other competing use.

WPA Proposed Action Scenario: A maximum of 246 ha (615 ac) (41 production structures of approximately 6 ha [15 ac]) of surface area will be lost to commercial fishing and other uses as a result of the WPA proposed action.

The net effect on total area available for commercial trawling and other uses will also be affected by structure removals. Structures removed in water depths <200 m (656 ft) in most cases would be taken to shore, resulting in trawl area being opened up. Approximately 10 percent of eligible structures removed are eventually used for rigs-to-reef. Those structures that may become artificial reef would open space where removed and take space where reefed. Even when platforms are transported to designated artificial reef planning areas, which already effectively prevent trawling, the net effect would again be additional trawling area. If platform removals are set against those installed, the effective net area taken for temporary OCS use because of additional platforms is eight platforms added to the WPA representing a net area taken of 48.5 ha (120 ac).

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS. Total number of production structure installations in the WPA has been estimated through the years 2007-2046 in Table 4-5 of the Multisale EIS. The total number of production structure installations projected for the OCS Program over this period is shown in Table 4-4 of the Multisale EIS for both the WPA and CPA as 2,958-3,262 for all depth ranges. The total number of structure removals through the years 2007-2046 in the WPA and CPA are 5,997-6,097. With nearly double the amount of platform removals as installations, there would be no net OSC Program area taken over the 40-year analysis period by additional platforms. Because of structure removals, the net effect over this time is that more OCS space would become available for other uses. Cleared areas would once again be available for commercial fishing or any other competing use in depth ranges where the activities are practiced.

3.1.1.2.2.4. Aesthetic Quality

Chapter 4.1.1.3.3.3 of the Multisale EIS and Chapter 3.1.1.2.2.3 of the 2009-2012 Supplemental EIS describe the impacting factors arising from aesthetic interference in the GOM as a result of a proposed action. The presence of drilling and production platforms visible from land, increased vessel and air traffic, and noise are aesthetic inferences associated with the proposed action and routine events. The aesthetics for industrialized infrastructure is a subjective judgment, but it is usually regarded as a negative aesthetic if facilities of this type are visible. Visibility of industrial structures on an open horizon that may be frequented by people precisely for the open horizon is a net negative aesthetic and a conflict in space use. The potential visibility of fixed structures in local GOM waters could be of concern to business operators, local chambers of commerce, and organizations promoting tourism. Installed facilities and increased vessel and air traffic add a component of additional noise as well as their physical presence on the seascape.

The natural curvature of the Earth renders a 60-ft (18-m) tall ship invisible to a person at sea level when >12 mi (19 km) from shore. The formula for the distance to the horizon is given as your eye height above sea level, plus the height of the object under view, then square root of that sum, multiplied by 1.5 (WikiHow, 2010). Rasmussen (2008) includes a calculator. A structure 250 ft (76 m) above sea level, such as an oil platform, would not be visible to 6-ft-tall beach goers if it is >24 mi (38 km) from shore. The WPA is 9 nmi (10 mi; 16 km) from the Texas shore and only under good weather conditions would a platform be visible to a person standing at the shoreline, or to a person in a multi-story building.

WPA Proposed Action Scenario: Because of the distance to shore, no structures installed in the WPA would be visible from shore at sea level under ordinary circumstances. Structures installed in the extreme western Louisiana OCS, just outside of the 3 nmi boundary, may be visible from shore in Texas.

OCS Program Scenario: Because of the distance to shore, no OCS structures in the WPA are now, or ever will be, visible from shore at sea level, while they operate.

3.1.1.2.2.5. Workovers and Abandonments

Chapter 4.1.1.3.4 of the Multisale EIS and Chapter 3.1.1.2.2.4 of the 2009-2012 Supplemental EIS discuss the impacting factors arising from workovers and abandonments in the GOM as a result of a proposed action. Completed and producing wells may require periodic reentry that is designed to maintain or restore a desired product flow rate. These procedures are referred to as a well "workover." Workover operations are also carried out to evaluate or reevaluate a geologic formation or reservoir (including recompletion to another formation) or to permanently abandon a part or all of a well. Workovers on subsea completions require that a rig be moved on location to provide surface support.

Workovers can take from 1 day to several months to complete, depending on the complexity of the operations, with a median of about 7 days. On the basis of historical data, BOEMRE projects a producing well may expect to have seven workovers or other well activities during its lifetime. There are two types of well abandonment operations—temporary and permanent. The operator must meet specific requirements to decommission and abandon a well under guidelines provided in the new NTL 2010-G05 (**Chapter 3.1.1.7**). The projected number of workovers is a function of producing wells, including one permanent abandonment operation per well.

WPA Proposed Action Scenario: As a result of the proposed action, there are 945-1,344 workovers and other well activities estimated to be completed within the WPA.

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS. There are 190,778-218,555 workovers and other well activities in this class estimated to be completed within the OCS Program through the years 2007-2046.

3.1.1.3. Major Sources of Oil Inputs in the Gulf of Mexico

Petroleum hydrocarbons can enter the GOM from a wide variety of sources. The major sources of oil inputs in the GOM are natural seepage, produced waters, land-based discharges, and spills. These sources are discussed in detail in Chapter 4.1.3.4 of the Multisale EIS and in Chapter 3.1.1.3 of the 2009-2012 Supplemental EIS. Numerical estimates of the contributions for these sources to the GOM coastal and offshore waters are shown in Tables 4-11 and 4-12 of the Multisale EIS, respectively. The information presented in the Multisale EIS is based on the National Research Council's (NRC's) *Oil in the Sea III: Inputs, Fates, and Effects* (NRC, 2003) and is summarized below. With the exception of the DWH event, which released 4.9 million bbl of oil in 2010, the estimates and contributions for major sources of oil inputs remain as described in Tables 4-11 and 4-12 of the Multisale EIS.

The GOM comprises one of the world's most prolific offshore oil-producing provinces as well as having heavily traveled tanker routes. Nevertheless, inputs of petroleum from onshore sources far outweigh the contribution from offshore activities. Human use of petroleum hydrocarbons is generally concentrated in major municipal and industrial areas situated along coasts or large rivers that empty into coastal waters.

Natural Seepage

Natural seeps typically provide the largest annual petroleum input to the offshore GOM, about 95 percent of the total. Mitchell et al. (1999) estimated a range of 280,000-700,000 bbl per year (40,000-100,000 tonnes per year), with an average of 490,000 bbl (70,000 tonnes) for the northern GOM, excluding the Bay of Campeche. Using this estimate and assuming seep scales are proportional to surface area, the NRC (2003) estimated annual seepage for the entire GOM at ~980,000 bbl (140,000 tonnes) per year, or about 3 times the estimated amount of oil spilled by the 1989 *Exxon Valdez* event (~270,000 bbl) (Steyn, 2010) or a quarter of the amount released by the DWH event (4.9 million bbl of oil) (Lubchenco et al., 2010). As seepage is a natural occurrence, the rate of ~980,000 bbl (140,000 tonnes) per year is expected to remain unchanged throughout the 40-year cumulative analysis period.

Produced Water

During OCS operations, small amounts of oil are routinely discharged in produced water, which is treated and discharged overboard according to USEPA regulations. Based on the volume of produced water generated, an average of about 17,500 bbl of oil is discharged in the Gulf of Mexico OCS each year (Etkin, 2009).

Land-based Discharges

Land-based sources provide the largest petroleum input to the coastal waters of the GOM. Land-based sources include residual petroleum hydrocarbons in municipal and industrial wastewater treatment facility discharges as well as urban runoff. The Mississippi River carries the majority of petroleum hydrocarbons into GOM waters from land-based drainage that occurs far upriver. With increased urbanization, particularly in coastal areas, the amount of impervious paved surface increases, and oil contaminants deposited on these roads and parking lot surfaces are washed into adjacent streams and waterbodies.

Spills

Oil spills occur during the production, transportation, and consumption of oil. The composition of spilled hydrocarbons includes crude oil, refined fuels such as diesel during transport and storage and spills during consumption. Chapter 4.1.3.4.4 of the Multisale EIS and Chapter 3.1.1.3 of the 2009-2012 Supplemental EIS, which discuss offshore and coastal spills and spills related to and not related to OCS activity, are summarized below. **Chapter 3.2.1** of this Supplemental EIS discusses potential spills associated with the proposed action, specifically.

At the national level, tankers and tank barges were responsible for 45 percent of the reported total spillage in the years 1969 through 2008 (U.S. Dept. of Homeland Security, CG, 2010a). The type of oil reported spilled nationally was as follows: 46 percent crude oil; 17 percent heavy fuel oil; 16 percent intermediate fuel oil; and 9 percent gasoline. Other reported petroleum and non-petroleum oils make up the remaining 11 percent (U.S. Dept. of Homeland Security, CG, 2010a). In the GOM, spills will vary according to activities conducted in the area. Spills from pipelines are the most common reported spill source of oil to the coastal waters of the western GOM. Spills from tankers are the most common spill source to coastal waters of the eastern GOM.

Spills could happen because of an accident associated with future OCS operations. Table 4-13 of the Multisale EIS provides the estimated number of all spill events (OCS and non-OCS) that BOEMRE projects will occur within coastal and offshore waters of the GOM area for a representative future year (around 15 years after the proposed action). Table 4-13 of the Multisale EIS distinguishes spill occurrence risk by likely operation or source and the estimated size of spills and shows the estimated number of annual OCS spills rather than for the 40-year program.

Spills as the Result of Hurricanes

Chapter 4.1.3.4.4.2 of the Multisale EIS and Chapter 3.1.1.3 of the 2009-2012 Supplemental EIS discuss the cause and volume of spills that resulted from the 2002-2005 hurricanes. When spills related to hurricane damage are first reported, the amount of spilled crude oil and fuel products are estimated. Once safety issues are resolved and a more accurate accounting of lost material is made, the volumes often are corrected downwards. Therefore, this Agency updates and publishes these estimates in the years following the hurricanes. This Supplemental EIS revises the Multisale EIS and the 2009-2012 Supplemental EIS estimates. The most recent revision of petroleum spills from Federal OCS facilities caused by major hurricanes in 2002-2008 is available (USDOI, MMS, 2009a). The reader should bear in mind that these are reported spills, not necessarily all spills that occur.

Table 3-4 indicates that spills caused by hurricane-damaged pipelines result in the vast majority of total oil spilled in the GOM. The BOEMRE reports production and spills in barrels; 1 bbl equals 42 U.S. gallons (gal). The USCG reports spills in gallons and classifies spills as minor, medium, or major. The table below presents the USCG volumes associated with spill size categories. The USCG's offshore spill size classifications are based solely on spill size, not impacts.

Spill Size	Volume of Oil Spilled
Minor	<238 bbl (<10,000 gal)
Medium	238-2,380 bbl (10,000-99,999 gal)
Major	≥2,381 bbl (≥100,000 gal)

- There were 231 spills totaling about 25,600 bbl identified as having occurred during or soon after the storms: 8 (totaling 1,631 bbl) from Hurricane Lili; 36 (totaling 4,645 bbl) from Hurricane Ivan; 73 (totaling 4,729 bbl) from Hurricane Katrina; 56 (totaling 8,734 bbl) from Hurricane Rita; and 58 (totaling 5,857 bbl) from Hurricanes Gustav and Ike.

- There were no major spills caused by any of the 2002-2008 hurricanes. The USCG defines a major offshore spill as a spill ≥100,000 gal (2,381 bbl) (based solely on size, not impacts).
- Of the 231 spills, 206 (89%) were minor, <238 bbl in size. These minor spills totaled <7,600 bbl, or about 30 percent of the spillage.
- There were a total of 25 medium spills, 238-2,380 bbl in size, totaling about 18,000 bbl (70% of the spillage): 3 from Hurricane Lili; 6 from Hurricane Ivan; 5 from Hurricane Katrina; 6 from Hurricane Rita; and 5 from Hurricanes Gustav and Ike. Only five of these medium spills were ≥1,000 bbl: 1 from Hurricane Ivan (1,720 bbl); 3 from Hurricane Rita (2,000 bbl, 1,572 bbl, and 1,494 bbl); and 1 from Hurricanes Gustav and Ike (1,316 bbl).
- Platforms and rigs were the source of 111 (48%) of the spills, totaling 16,838 bbl (66% of the spillage).
- Pipelines were the source of 120 (52%) of the spills identified, totaling 8,758 bbl (34% of the spillage).
- There were 80 spills of ≥50 bbl.

There were no accounts of environmental consequences resulting from spills from OCS facilities that occurred during these major hurricanes from 2002 through 2008. Impacts included the following (USDOI, MMS, 2009a):

- no spill contacts to the shoreline;
- no oiling of marine mammals, birds, or other wildlife;
- no large volumes of oil on the ocean surface to be collected or cleaned up; and
- no identified environmental impacts from any OCS spills from these hurricanes.

Offshore Spills

The OCS-related offshore spills and non-OCS-related offshore spills are addressed in Chapters 4.1.3.4.4.4 and 4.1.3.4.4.5 of the Multisale EIS, respectively, and in Chapter 3.1.1.3 of the 2009-2012 Supplemental EIS. One OCS-related offshore spill of ≥1,000 bbl per year because of a pipeline release is anticipated. Besides spills occurring from facilities and during pipeline transport offshore spills could occur because of future FPSO operation or from shuttle tankers transporting OCS crude oil into ports. Table 4-13 of the Multisale EIS includes the likelihood of a spill from a shuttle-tanker accident carrying OCS-produced crude oil. The scenario with the highest risk of spill occurrence is the high-case resource estimate for the OCS Program in the CPA, which assumes some shuttle-tanker transport of OCS-produced oil. Under that scenario, there is a 63 percent chance that a spill ≥1,000 bbl and a 29 percent chance that a spill ≥10,000 bbl would occur from an OCS-related shuttle tanker during the 40-year cumulative analysis period. Offshore spill sizes were estimated based on historical records for a representative future year (Anderson and LaBelle, 2000).

Offshore OCS Program spills <1,000 bbl were estimated based on historical records collected from 1985 to 2001, and about 450-500 spills <1,000 bbl occurred from OCS offshore sources yearly. Less documentation is available for spills <1,000 bbl because they are more routine, they do not persist on the water as long, and they are likely to pose less of an environmental threat than larger spills. Additionally, many of the reported spills are of an unknown origin.

Non-OCS-related offshore spills ≥1,000 will occur from the extensive maritime barging and tankering operations that occur in offshore waters of the GOM. The analysis of spills from tankers and barges ≥1,000 bbl is based on data obtained from USCG and analyzed by BOEMRE. Less than one spill ≥1,000 bbl is projected to occur in the offshore GOM for a typical future year from the extensive tanker and barge operations (Table 4-13 of the Multisale EIS).

Coastal Spills

Table 4-13 of the Multisale EIS provides BOEMRE's projections of the number of spills that are projected to occur in the coastal waters of the GOM (State offshore and inland coastal waters) in a typical future year as a result of operations that support the OCS Program.

The OCS-related coastal spills are addressed in Chapter 4.1.3.4.4.6 of the Multisale EIS and in Chapter 3.1.1.3 of the 2009-2012 Supplemental EIS. The OCS-related coastal spills primarily occur from pipeline ruptures. An OCS-related spill in coastal waters of ≥1,000 bbl and related to the proposed activity will occur less than once per year—about once every 6 years. An OCS-related spill ≥1,000 bbl would likely be from a pipeline accident for OCS coastal spills ≥1,000 bbl; where a spill size of 4,200 bbl is assumed. Smaller spills occur more regularly. Roughly 40-50 spills per year of <1,000 bbl related to the proposed activity on the OCS are estimated to occur in coastal waters. It is assumed that the spill risk would be widely distributed in the coastal zone, but it would primarily be within the Houston/Galveston area of Texas and the deltaic area of Louisiana due to the high proportion of oil being piped into these areas. Based on a BOEMRE analysis of USCG data on all U.S. coastal spills by volume, 42 percent of the spills will occur in State offshore waters, 1.5 percent will occur in Federal offshore waters, and 57 percent will occur in inland waters. It is assumed all coastal spills will contact land and proximate resources. For OCS-related coastal spills <1,000 bbl, a spill size of 5 bbl is assumed.

Non-OCS-related coastal spills are addressed in Chapter 4.1.3.4.4.7 of the Multisale EIS and in Chapter 3.1.1.3 of the 2009-2012 Supplemental EIS. Non-OCS-related coastal spills primarily occur from vessel accidents. Other sources include spills during the pipeline transport of petroleum products; crude oil; State oil and gas facilities; petrochemical refinery accidents; and storage tanks at terminals. A non-OCS-related coastal spill ≥1,000 bbl occurred roughly once every 2 years in the 1985-2001 USCG records. This is a very rough estimate because of the infrequent occurrence of a spill of this size in coastal waters. Non-OCS-related coastal spills <1,000 bbl occurred annually at a rate of 400-600 per year in the 1996-2001 USCG data. Many of the reported spills are from an unknown source. Based on a BOEMRE analysis of U.S. spill data maintained by USCG (U.S. Dept. of Homeland Security, CG, 2010a), the historical percentages of coastal spill occurrences in different waterbody types were calculated to be as follows: 47 percent have occurred in rivers and canals; 19 percent in bays and sounds; and 34 percent in harbors.

3.1.1.4. Offshore Transport

Chapter 4.1.1.8 of the Multisale EIS and Chapter 3.1.1.4 of the 2009-2012 Supplemental EIS describe the impact-producing factors arising from the transportation of products, supplies, and personnel in the GOM for a proposed action. The discussion in this Supplemental EIS tiers from the discussions in the Multisale EIS and the 2009-2012 Supplemental EIS.

3.1.1.4.1. Pipelines

Chapter 4.1.1.8.1 of the Multisale EIS and Chapter 3.1.1.4.1 of the 2009-2012 Supplemental EIS describe the existing pipeline network in the GOM, installation trends, installation methods, pipeline burial, and issues related to deep water. A mature pipeline network exists in the GOM to transport oil and gas production from the OCS to shore. There are currently 106 OCS-related pipeline landfalls (pipelines that have at one time or another carried hydrocarbon product from the OCS) in the Louisiana Coastal Area (LCA) (USDOI, MMS, 2007b, Table 3-38). Included in this number of pipeline landfalls is a subset of 47 pipeline systems under DOT jurisdiction originating in Federal waters and terminating onshore or in Louisiana State waters (Gobert, 2010) (**Figure 3-2**). There are 69 OCS-related pipelines that transition into Texas State lands or that make landfall onshore, many of which switch back across this boundary (**Figure 3-2)**. The BOEMRE and DOT share responsibility for pipeline regulation on the OCS in the transition between Federal and State waters. The BOEMRE has jurisdiction over producer-operated pipelines that extend upstream from the wellbore to the point downstream (the last valve on production infrastructure) on the OCS at which responsibility transfers from a producing operator to a transporting operator. The DOT's jurisdiction lies with transporter-operated pipelines that tend to be larger diameter trunk lines that service multiple facilities or pipeline tie-ins from offshore.

The OCS-related pipelines nearshore and onshore may merge with pipelines carrying materials produced in State lands for transport to processing facilities or to connections with pipelines located farther inland. At present, all gas production and >99 percent of oil production from the offshore GOM is transported to shore by pipeline.

The BOEMRE's minimum cathodic protection design criteria for pipeline external corrosion protection is 20 years. For the most part, pipelines have a designed life span greater than 20 years and, if needed, can be retrofitted to increase the life span. As for internal corrosion mitigation, operators are required to monitor products transported through the pipelines for corrosiveness. Based on the type of production, a company then enhances the pipeline internal corrosion protection by injecting appropriate corrosion inhibitors and monitoring effectiveness to prevent pipeline failures, thus extending the life of a pipeline. It should be noted that different products have different corrosive characteristics. Should a pipeline need to be replaced because of integrity issues, a replacement pipeline is installed or alternate routes are used to transport the products, or a combination of the two. Besides replacement because of integrity issues, a pipeline may also be required to be replaced as a result of storm or other damages. The BOEMRE estimates that the overall pipeline replacement over the past few years is about 1 percent of the total installed. Natural gas transportation by means other than pipelines, for example as LNG, is possible, but is not part of the proposed action or the OCS Program scenario.

Newer installation methods have allowed the pipeline infrastructure to extend farther into deep water. At present, the deepest pipeline in the Gulf is in water 2,700 m (8,858 ft) deep. More than 500 pipelines reach water depths of 400 m (1,312 ft) or more, and over 400 of those pipelines reach water depths of 800 m (2,625 ft) or more. These technical challenges are described in more detail in *Deepwater Gulf of Mexico 2006: America's Expanding Frontier* (USDOI, MMS, 2006b).

Pipeline Landfalls

Up to one (i.e., 0-1) new pipeline landfall is projected per OCS lease sale (USDOI, MMS, 2007d, p. 1). The BOEMRE anticipates that pipelines from most of the new offshore production facilities will tie in to the existing pipeline infrastructure offshore or in State waters, which will result in few new pipeline landfalls. Production from the WPA proposed action will contribute to the capacity of existing and future pipelines and pipeline landfalls. According to BOEMRE regulations (30 CFR 250.1003(a)(1)), pipelines with diameters ≥8⅝ inches (in) (22 centimeters [cm]) that are installed in water depths <60 m (200 ft) are to be buried to a depth of at least 3 ft (1 m) below mudline. The regulations also provide for the burial of any pipeline, regardless of size, if BOEMRE determines that the pipeline may constitute a hazard to other uses of the OCS in the GOM. The BOEMRE has determined that all pipelines installed in water depths <60 m (200 ft) must be buried. The purposes of these requirements are to (1) reduce the movement of pipelines during high sea states by storm currents and waves, (2) protect the pipeline from the external damage that could result from anchors and fishing gear, (3) reduce the risk of fishing gear becoming snagged, and (4) minimize interference with the operations of other users of the OCS. Where pipeline burial is necessary, a jetting sled would be used. Jetting disperses sediments over the otherwise undisturbed water bottom that flanks the jetted trench. The area covered by settled sediment and the thickness of the settled sediment depends upon variations in sea bottom grain size, bottom topography, sediment density, and currents. Sediment displacement due to pipeline burial is further explained in Chapter 4.1.1.3.2.2 of the Multisale EIS.

WPA Proposed Action Scenario: The BOEMRE projects 130-760 km (8-472 mi) of new pipelines as a result of the WPA proposed action (**Table 3-2**). For the WPA proposed action, about half of the new pipeline length would be in water depths <60 m (197 ft), requiring burial. For the WPA proposed action, 0-1 new pipeline landfalls are projected. The length of new pipelines was estimated using the amount of production, the number of structures projected as a result of the proposed action, and the location of the existing pipelines. The range in length of pipelines projected is because of the uncertainty of the location of new structures, which existing or proposed pipelines would be used, and where they tie in to existing lines. Many factors would affect the actual transport system, including company affiliations, amount of production, product type, and system capacity.

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS. Table 4-4 of the Multisale EIS projected that 9,470-66,550 km

(5,884-41,352 mi) of new pipelines in support of the OCS Program during the years 2007-2046 would be built.

3.1.1.4.2. Barges

Chapters 3.3.5.8.9 and 4.1.1.8.2 of the Multisale EIS and Chapter 3.1.1.4.2 of the 2009-2012 Supplemental EIS describe the use of barges and oil barging. Barges may be used offshore to transport oil and gas, supplies such as chemicals or drilling mud, or wastes between shore bases and offshore platforms in shallow waters (<60 m; <200 ft) of the GOM. A small amount (<1%) of oil production is barged in shallow water (<60 m; <200 ft).

WPA Proposed Action Scenario: The BOEMRE projects that barging will continue to account for ≤1 percent of the oil transported for the WPA proposed action.

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS; that the current rate of barging would continue during the years 2007-2046 at about that same level as today or slightly less as production on the GOM tapers off in the second half of the 40-year production period.

3.1.1.4.3. Oil Tankers

Chapter 4.1.1.8.3 of the Multisale EIS and Chapter 3.1.1.4.3 of the 2009-2012 Supplemental EIS discuss the use of FPSO's and shuttle tankers for the transportation of OCS oil. Shuttle tanker transport of Gulf of Mexico OCS-produced oil in a purpose-built FPSO system has not yet occurred; however, Petrobras had planned the Cascade-Chinook fields' first production from an FPSO and shuttle tanker system in mid-2010; however, delays following the DWH event has made scheduling difficult to predict. An FPSO was approved in March 2011. Tankering related to FPSO systems is projected for some future OCS operations located in deep water beyond the existing pipeline network. The FPSO's store crude oil in tanks in the hull of the vessel and periodically offload the crude to shuttle tankers or oceangoing barges for transport to shore. The FPSO's may be used to develop marginal oil fields or used in areas remote from the existing OCS pipeline infrastructure, especially development in the Lower Eocene Wilcox trend (Walker Ridge leasing area) that is far from most existing pipeline networks. As a result of the WPA proposed action, the use of FPSO's and shuttle tankering are only projected in water depths >800 m (2,625 ft). Shuttle tankers would be used to transport crude oil from FPSO production systems to Gulf Coast refinery ports or to offshore deepwater ports such as the Louisiana Offshore Oil Port. The shuttle tanker design and systems would be in compliance with USCG regulations. Under the Jones Act and OPA requirements, shuttle tankers would be required to be double hulled. In the Gulf, the maximum size of shuttle tankers is limited primarily by the 34- to 47-ft (10- to 14-m) water depths. Because of these depth limitations, shuttle tankers are likely to be 500,000-550,000 bbl in cargo capacity.

Safety features, such as marine break-away offloading hoses and emergency shut-off valves, would minimize the potential for, and size of, an oil spill. In addition, weather and sea-state limitations would be established to further ensure that hook-up and disconnect operations will not lead to accidental oil release. A vapor recovery system between the FPSO and shuttle tanker will be employed to minimize the release of fugitive emissions from cargo tanks during offloading operations. The FPSO systems are suitable for the light and intermediate oils of the GOM, as well as heavier oil, such as the heavy oil Brazil plans to produce offshore in deep water. The number of shuttle-tanker trips to port in a given year is primarily a function of the FPSO production rate and the capacity of supporting shuttle tankers.

WPA Proposed Action Scenario: There is one FPSO system ready to operate in the deepwater Gulf. The BOEMRE projects 0-1 FPSO systems could result from the WPA proposed action. For an FPSO operating at a peak production of 150,000 bbl/day, offloading would occur once every 3.3 days by a shuttle tanker with a 500,000-bbl cargo capacity transporting an upper-bound estimate of 54.75 MMbbl with 110 offloading events and shuttle tanker transits to offshore ports annually per FPSO system.

OCS Program Scenario: The OCS Program scenario did not offer a projection for shuttle tanker transport in the Multisale EIS because no FPSO system was then proposed in the GOM. As industry continues to explore the Eocene Wilcox trend, industry's interest level in the potential for the trend remains high, but flow assurance in these reservoirs remains a concern.

3.1.1.4.4. Service Vessels

Chapter 4.1.1.8.4 of the Multisale EIS and Chapter 3.1.1.4.4 of the 2009-2012 Supplemental EIS discuss the use of service vessels for transportation. Service vessels are one of the primary modes of transporting personnel between service bases and offshore platforms, drilling rigs, derrick barges, and pipeline construction barges. In addition to offshore personnel, service vessels carry cargo (i.e., freshwater, fuel, cement, barite, liquid drilling fluids, tubulars, equipment, and food) offshore. A trip is considered the transportation from a service base to an offshore site and back, in other words a round trip. Based on BOEMRE calculations, each vessel makes an average of eight round trips per week for 42 days in support of drilling an exploration well and six round trips per week for 45 days in support of drilling a development well. A platform in shallow water (<400 m; 1,312 ft) is estimated to require one vessel trip every 10 days over its 25-year production life. A platform in deep water (>400 m; 1,312 ft) is estimated to require one vessel trip every 1.75 days over its 25-year production life. All trips are assumed to originate from the designated service base.

WPA Proposed Action Scenario: The WPA proposed action is estimated to generate 76,000-141,000 service-vessel trips over the 40-year period (**Table 3-2**) or 1,900-3,525 trips annually. Table 3-36 of the Multisale EIS indicates over 1.52 million service-vessel trips occurred on Federal navigation channels, ports, and OCS-related waterways in 2004. The number of service-vessel trips projected annually for the WPA proposed action would represent <1 percent of the total annual traffic on these OCS-related waterways.

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS. The projected number of service-vessel trips for the OCS Program is 6.71-8.6 million trips during the years 2007-2046 (Table 4-4 of the Multisale EIS).

3.1.1.4.5. Helicopters

Chapters 3.3.5.7.2.4 and 4.1.1.8.5 of the Multisale EIS and Chapter 3.1.1.4.5 of the 2009-2012 Supplemental EIS discuss the use of helicopters for the transportation of OCS crews and materials in support of OCS activities. The proposed action and OCS Program scenarios below use the current level of activity as a basis for projecting future helicopter operations. Helicopters are one of the primary modes of transporting personnel between service bases and offshore platforms, drilling rigs, derrick barges, and pipeline construction barges. Helicopters are routinely used for normal crew changes and at other times to transport management and special service personnel to offshore exploration and production sites. In addition, equipment and supplies are sometimes transported by helicopter. The Federal Aviation Administration (FAA) regulates helicopter flight patterns. Because of noise concerns, FAA Circular 91-36C encourages pilots to maintain higher than minimum altitudes near noise sensitive areas. Corporate policy (for all helicopter companies) states that helicopters should maintain a minimum altitude of 700 ft (213 m) while in transit offshore and 500 ft (152 m) while working between platforms and drilling rigs. When flying over land, the specified minimum altitude is 1,000 ft (305 m) over unpopulated areas and coastlines, and 2,000 ft (610 m) over populated areas and sensitive areas including national parks, recreational seashores, and wildlife refuges. In addition, guidelines and regulations issued by NMFS under the authority of the MMPA include provisions specifying helicopter pilots to maintain an altitude of 1,000 ft (305 m) within 100 yd (91 m) of marine mammals. According to the Helicopter Safety Advisory Conference (2009), from 1996 to 2009, helicopter operations (take offs and landings) in support of Gulfwide OCS operations have averaged, annually, about 1.4 million operations, over 3.0 million passengers, and 430,000 flight hours. There has been a decline in helicopter operations from 1,668,401 in 1996 to 1,397,508 in 2009 (Helicopter Safety Advisory Conference, 2009).

WPA Proposed Action Scenario: There are 400,000-900,000 helicopter trips projected over the 40-year period for the WPA proposed action (**Table 3-2**), or 10,000-22,500 trips annually.

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS. Table 4-4 of the Multisale EIS projects 38-60 million helicopter trips for the OCS Program for the years 2007-2046.

3.1.1.5. Operational Wastes and Discharges

Chapter 4.1.1.4 of the Multisale EIS describes the impacting factors arising from operational wastes and discharges in the GOM resulting from a proposed action. The discussion in this Supplemental EIS tiers from the discussion in the Multisale EIS. Because these wastes and discharges are USEPA-permitted routine wastes types and volumes, they are also discussed under water quality as an impact of routine events (**Chapter 4.1.2.2.2**). Aside from the reissuance of expiring general NPDES permits by USEPA, there has been very little change in the topic of wastes and discharges. Volumes or wastes and discharges are dependant upon the level of activity, and hence, operations in the GOM.

The USEPA, through general permits issued by the Region that has jurisdictional oversight, regulates all waste streams generated from offshore oil and gas activities. Each USEPA Region has promulgated general permits for discharges that incorporate the 1993 and 2001 effluent limitations guidelines as a minimum. The current Region 6 general permit (GMG290000) was issued on June 7, 2007, and expires September 30, 2012 (USEPA, 2007a). In accordance with BOEMRE's air quality regulations, BOEMRE applies defined criteria to determine which OCS plans require an air quality review and performs an impact analysis on the selected plans to determine whether the emission source would potentially cause a significant onshore impact.

Drilling Muds and Cuttings

Drilling mud and cuttings are described in Chapter 4.1.1.4.1 of the Multisale EIS. Drilling fluid is used during the drilling of exploration and development wells. These fluids are very dense and are circulated down the wellbore to pick up and remove drill bit cuttings, after which the mixture of entrained cuttings and fluid is referred to as drilling mud.

The composition of drilling fluids is complex. Drilling fluids used on the OCS are divided into two categories: water based and nonaqueous based, in which the continuous phase is not soluble in water. Clays, barite, and other chemicals are added to the base fluid, which can be freshwater or saltwater in water-based fluids (WBF's), mineral or diesel oil-based fluids (OBF's), or synthetic-based fluids (SBF's). Additional chemicals may be added to improve the performance of the drilling fluid (Boehm et al., 2001).

Drilling mud is reconditioned and recirculated at the surface. The OBF's are rarely used in GOM operations, while SBF's may be preferred for certain deepwater prospects. If used, OBF's and SBF's must be recovered and taken to shore for recycling. Only water-based drill mud meeting USEPA's NPDES permit requirements may be discharged to the sea. Barite is a major mineral component of all drilling fluid types. Barite is used to "heavy up" drilling mud because of the high specific gravity of barite. Adding barite makes drilling mud denser and heavier. Many other products are added to improve and condition the drilling fluid. Drilling mud that is discharged must meet USEPA's NPDES permit requirements that include limits on trace metal concentrations, free oil, and toxicity. The USEPA regulates the NPDES permit program in the WPA.

Cuttings are the chipped and fragmented rock that is broken and removed by the rotating drilling bit and brought to the surface entrained in drilling fluid. Cuttings may be discharged if they meet the USEPA's NPDES permit requirements that include limits on adhered synthetic mud, if used, as well as limits on trace metals, toxicity, polycyclic aromatic hydrocarbons, and free oil.

Produced Waters

Produced waters are described in Chapter 4.1.1.4.2 of the Multisale EIS. Produced water is water that originates from or passes through the hydrocarbon-bearing geological strata and is brought to the surface with oil and gas during production. This waste stream can include formation water; injection water; well treatment, completion, and workover compounds added downhole; and compounds used during the oil and water separation process. Formation water, also called connate water or fossil water, originates in the permeable sedimentary rock strata and is brought up to the surface commingled with the oil and gas. Injection water is water that was injected to enhance oil production and in secondary oil recovery.

Produced water is the largest volume byproduct associated with oil and gas exploration and production (Clark and Veil, 2009). The vast majority of OCS produced water is treated to remove oil and grease to a concentration below 29 milligrams/liter (mg/L) monthly average and discharged. In the OCS waters off the State of Texas, less produced water is generated because these wells tend to be gas. The oil wells in the OCS waters off the State of Louisiana generated greater volumes of produced water. Clark and Veil (2009) have determined the ratio of produced water to oil and gas on the OCS to be 1.04 bbl produced water to 1 bbl oil, and 86.0 bbl produced water to 1 million cubic feet (MMcf) of gas, respectively. The USEPA's general permit allows the discharge of produced water on the OCS provided they meet discharge criteria.

Well-Treatment, Workover, and Completion Fluids

Well-treatment, workover, and completion fluids are described in Chapter 4.1.1.4.3 of the Multisale EIS. Completion fluids are used to displace the drilling fluid and protect formation permeability. Workover fluids are used to maintain or improve existing well conditions and production rates on wells that have been in production. These fluids include mixtures of seawater with various salts, such as calcium chloride and calcium bromide, and may include defoamers and corrosion inhibitors or acids to increase formation permeability.

Production treatment fluids are chemicals applied during the oil and gas extraction process. Production chemicals are used to dehydrate produced oil or treat the associated produced water for reuse or disposal. Both USEPA Regions 4 and 6 allow the discharge of well-treatment, completion, and workover fluids that meet the specified guidelines. Production chemicals consist of corrosion and scale inhibitors, bactericides, paraffin solvents, demulsifiers, foamers, defoamers, and water treatment chemicals.

The USEPA Region 6 allows the discharge of well-treatment, completion, and workover fluids that meet the specified guidelines; although if recoverable in concentration, they may be collected and recycled at an onshore facility.

Production Solids and Equipment

Production solids are described in Chapter 4.1.1.4.5 of the Multisale EIS. Produced sands are entrained particles that surface after hydraulic fracturing, and sand disassociated from the formation, along with other particles including pipe scale that are produced. Production solids may not be discharged overboard and are collected on the production platform, stored, and ultimately transported to shore for disposal. The solids are disposed of as nonhazardous oil-field waste according to individual State regulations.

Deck Drainage

Deck drainage is described in Chapter 4.1.1.4.5 of the Multisale EIS. Deck drainage includes all wastewater resulting from platform washings, deck washings, rainwater, and runoff from curbs, gutters, and drains, including drip pans and work areas, that is collected in separators that can remove oils and greases before overboard discharge. The USEPA's general guidelines for deck drainage require that no free oil be discharged, as determined by visual sheen.

Domestic and Sanitary Wastes

Domestic and sanitary wastes are described in Chapter 4.1.1.4.6 of the Multisale EIS. As with the waste streams discussed above, domestic and sanitary wastes may be discharged when they are treated to meet USEPA-regulated parameters. Most service and crew vessels use a marine sanitation device Type III that stores sanitary wastes in tanks aboard ship until transferred to treatment facilities onshore at the service base.

Vessel Operational Wastes

Vessel operational wastes are described in Chapter 4.1.1.4.8 of the Multisale EIS. Vessel regulations come under the jurisdiction of USCG. The USCG and USEPA have cooperatively set regulatory limits for wastes, such as sanitary waste, which both agencies regulate, depending upon vessel type and location. Regulated wastes include bilge and ballast waters, trash and debris, and sanitary and domestic wastes.

Trash and Debris

Trash and debris are described in Chapter 4.1.1.5 of the Multisale EIS. The OCS oil and gas operations generate trash and debris materials made of paper, plastic, wood, glass, and metal. Most of this trash is associated with galley and offshore food service operations and with operational supplies such as shipping pallets, containers used for drilling muds and chemical additives (sacks, drums, and buckets), and protective coverings used on mud sacks and drilling pipes (shrink wrap and pipe-thread protectors). Trash is collected and stored on the lower deck near the loading dock in large receptacles resembling dumpsters. These large containers are generally covered with netting to avoid loss and are returned to shore by service vessels for disposal in landfills. Drilling operations require the most supplies, equipment, and personnel; therefore, drilling operations generate more solid trash than production operations. Chapter 1.3 of the Multisale EIS describes laws and regulations, including the Marine Plastic Pollution Research and Control Act and Marine Debris Research, Prevention and Reduction Act, which are related to collecting, processing, storing, and discharging garbage generated by oil and gas operators.

Noise

Noise is described in Chapter 4.1.1.7 of the Multisale EIS. Coastal noise associated with OCS oil and gas development results from helicopter and service-vessel traffic. Sound generated from these activities can be transmitted through both air and water, and may be continuous or transient. Service vessels transmit noise through both air and water. The primary sources of vessel noise are propeller cavitation, propeller singing, and propulsion; other sources include auxiliaries, flow noise from water dragging along the hull, and bubbles breaking in the wake (Richardson et al., 1995). Propeller cavitation is usually the dominant noise source. The intensity of noise from service vessels is roughly related to ship size and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladen vessels. Noise increases with ship speed; ship speeds are often reduced in restricted coastal waters and navigation channels.

Helicopters often radiate more sound forward than backward, and the underwater noise is generally brief in duration, compared with the duration of audibility in the air. Water depth and bottom conditions strongly influence propagation and levels of underwater noise from passing aircraft.

Air Emissions

Air emissions are described in Chapter 4.1.1.6 of the Multisale EIS. In 1990, pursuant to Section 328 of the Clean Air Act Amendments and following consultation with the Commandant of the U.S. Coast Guard and the Secretary of the Interior, USEPA assumed air quality responsibility for the OCS waters east of 87.5^{o} W. longitude and this Agency retained NAAQS air quality jurisdiction for OCS operations west of 87.5^{o} W longitude in the GOM. The area of the proposed action is under BOEMRE jurisdiction for air emissions.

Air pollutants are emitted from the OCS emission sources that include any equipment that combusts a fuel, transports and/or transfers hydrocarbons, or results in accidental releases of petroleum hydrocarbons or chemicals, causing air emissions of pollutants. Some of these pollutants are precursors to ozone, which is formed by complex photochemical reactions in the atmosphere. Air pollutants are generated during exploration and production activities when fuels are combusted to run drilling equipment, power generators, and run engines. During production, fugitive emissions, including volatile organic compounds, escape from valves and flanges. Criteria air pollutants are also generated along routes from shore bases to OCS leases by vessels transporting supplies and workers.

Certain air pollutants subject to the NAAQS are also released during both venting and flaring. A combustion flare or cold vent is a specially designed boom or stack used to dispose of hydrocarbon vapors or natural gas. Unlike cold vents, the hydrocarbons are ignited during flaring. Flares can be used routinely to control emissions as part of unloading/testing operations that are necessary to remove potentially damaging completion fluids from the wellbore and to provide sufficient reservoir data for the operator to evaluate a reservoir and development options; they can also be used during emergency process upsets. The BOEMRE regulations provide for some limited volume, short duration flaring or venting of oil and natural gas upon approval by BOEMRE (2-14 days, typically). Through 30 CFR 250.1162, BOEMRE may allow operators to burn liquid hydrocarbons if they can demonstrate that transporting them to market or re-injecting them into the formation is not technically feasible or poses a significant risk of harm to the environment. During the DWH event, BP received permission from BOEMRE to burn oil and flare gas because the lessee initiated an action which, when completed, will eliminate the need for flaring. In this case the action was a relief well to kill the Macondo spill.

3.1.1.6. Safety Issues

This chapter describes safety issues arising in the GOM resulting from the proposed action. These issues include (1) hydrogen sulfide and sulfurous petroleum, (2) shallow hazards, and (3) new and unusual technologies.

3.1.1.6.1. Hydrogen Sulfide and Sulfurous Petroleum

Chapter 4.1.1.9 of the Multisale EIS and Chapter 3.1.1.5.1 of the 2009-2012 Supplemental EIS describe the impacting factors arising from hydrogen sulfide (H_2S) and sulfurous petroleum in the GOM resulting from a WPA proposed action. Sulfur may be present in oil as elemental sulfur, within gas as H_2S, or within organic molecules, all three of which vary in concentration independently. Safety and infrastructure concerns include the following: irritation, injury, and lethality from leaks; exposure to sulfur oxides produced by flaring; equipment and pipeline corrosion; and outgassing and volatilization from spilled oil.

Sour oil and gas occur sporadically throughout the Gulf of Mexico OCS, primarily off the Louisiana, Mississippi, and Alabama coasts. Sour hydrocarbon tends to originate in carbonate source or reservoir rocks that may not have abundant clay minerals that serve as a binder for elemental sulfur. If not bound in clay minerals, it remains free and can become a part of any hydrocarbon produced or sourced from that rock.

Deep gas reservoirs on the GOM continental shelf are likely to have high corrosive content, including H_2S. Occurrences of H_2S offshore Texas are in Miocene rocks and occur principally within a geographically narrow band. There is some evidence that petroleum from deepwater areas may be sulfurous, but exploration wells have not identified deepwater areas that are extraordinarily high in H_2S concentration.

The BOEMRE reviews all exploration and development plans in the Gulf of Mexico OCS for the possible presence of H_2S in the area(s) identified for exploration and development activities. Activities determined to be associated with a presence of H_2S are subjected to further review and requirements. Federal regulations at 30 CFR 250.490 require all lessees, prior to beginning exploration or development operations, to request a classification of the potential for encountering H_2S. The classification is based on previous drilling and production experience in the areas surrounding the proposed operations, as well as other factors.

All operators on the OCS involved in production of sour gas or oil (i.e., >20 ppm) are also required to file an H_2S Contingency Plan. This plan lays out procedures to ensure the safety of the workers on the production facility. In addition, all operators are required under 30 CFR 250.107 to adhere to the National Association of Corrosion Engineers' (NACE) *Standard Material Requirements—Methods for Sulfide Stress Cracking and Stress Corrosion Cracking Resistance in Sour Oilfield Environments* (NACE MR0175-2003) (NACE, 2003) as best available and safest technology. These engineering standards preserve the integrity of infrastructure through specifying equipment to be constructed of materials with metallurgical properties that resist or prevent sulfide stress cracking and stress corrosion cracking in the presence of sour gas. This Agency issued a final rule (30 CFR 250.490; *Federal Register*, 1997a) governing requirements for preventing hydrogen sulfide releases, detecting and monitoring hydrogen sulfide and sulfur dioxide, protecting personnel, providing warning systems and signage, and establishing requirements for hydrogen sulfide flaring and venting.

3.1.1.6.2. Shallow Hazards

The Multisale EIS did not contain a discrete discussion about shallow hazards. Pre-drill seismic assessment of drilling hazards is an essential part of the well planning process. The type of high-resolution seismic surveys that are deployed to collect the data used for shallow hazards analyses are described in **Chapter 3.1.1.1.1**.

Shallow hazard assessments are required by BOEMRE regulation (30 CFR 250.214 and 30 CFR 250.244); NTL 2008-G05, "Shallow Hazards Program," explains the requirements for these surveys and their reports. Included in shallow hazard assessment is a structural and stratigraphic interpretation of seismic data to qualitatively delineate abnormal pressure zones, shallow free gas, seafloor instability, shallow water flow, and gas hydrates.

The objective of the shallow hazard assessment is to identify, map, and delineate seafloor, shallow subsurface geologic features, and man-caused obstructions that may impact proposed oil and gas operations, which include the following:

- seafloor geologic hazards such as fault scarps, gas vents, unstable slopes, and reefs;
- shallow subsurface geologic hazards such as faults, gas hydrates and gas-charged sediments, buried channels, and abnormal pressure zones; and
- synthetic hazards such as pipelines, wellheads, shipwrecks, military ordnance (offshore disposal sites), and debris from oil and gas operations.

The shallow hazards survey is also used to identify and map geologic features in the vicinity of proposed wells, platforms, anchors and anchor chains, mounds or knolls, acoustic void zones, gas- or oil-charged sediments, or seeps associated with surface faulting that may be indicative of ocean-bottom chemosynthetic communities.

Since 1987, operators have reported shallow waterflow events to this Agency. These events are a phenomenon encountered in water depths exceeding 600 ft (183 m). Reported waterflows are between a few hundred feet to more than 4,000 ft (1,219 m) below the seafloor. Water flowing up and around the well casing and annulus may deposit sand or silt on the seafloor within a few hundred feet of the wellhead. Although in most cases there is no gas content in the waterflow, in these water depths a stream of gas bubbles may form frozen gas hydrates at the sea bottom and on flat surfaces of seafloor drilling equipment. Shallow waterflows can result from buried channels filled with more permeable sediment. Abnormally pressured shallow sands may result from either rapid slumping or rotating faults or from reworked cut-and-fill channels sealed by impermeable mud or clay. In rare cases, hydrates below the mudline could be a source of shallow waterflow by melting down hydrates during oil production. Shallow waterflow events can cause additional expenditure of time and money for the driller to maintain well control and can lead to drilling difficulty up to and including a decision to permanently plug and abandon the well. Unanticipated shallow hazards can lead to downhole pressure kicks that range from minor and controllable to significant and uncontrollable; up to and including a serious blowout condition.

3.1.1.6.3. New and Unusual Technology

Chapter 4.1.1.10 of the Multisale EIS discusses the impacting factors arising from the environmental and engineering safety review processes for new and unusual technology in the GOM resulting from a proposed action. The discussion in this Supplemental EIS tiers from the discussion in the Multisale EIS.

Operators must identify new and unusual technology in exploration and development plans. The new and unusual technologies are reviewed by BOEMRE for alternative compliance with permits or departures that may trigger additional environmental review.

In addition to new and unusual technology for drilling, as a result of the DWH event, many technologies or applications were developed in attempting to stop the spill and kill the well. The NTL 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources," applies to operators conducting operations using subsea BOP's or surface BOP's on floating facilities. The BOEMRE will assess whether each lessee has submitted adequate information demonstrating that it has access to and can deploy surface and subsurface containment resources that would be adequate to promptly respond to a blowout or other loss of well control. Containment resources could consist of, but are not limited to, subsea containment and capture equipment including containment domes and capping stacks, subsea utility equipment including hydraulic power, hydrate control, and dispersion injection equipment.

3.1.1.7. Decommissioning and Removal Operations

Chapter 4.1.1.11 of the Multisale EIS and Chapter 3.1.1.6 of the 2009-2012 Supplemental EIS describe impacting factors arising from decommissioning and removal operations in the GOM. The discussion in this Supplemental EIS tiers from the discussion in the Multisale EIS and in the 2009-2012 Supplemental EIS.

The BOEMRE's regulations for wellheads/casing (30 CFR 250.1710) platforms and other facilities (30 CFR 250.1725) require operators to remove all seafloor obstructions from their leases within 1 year of lease termination or relinquishment. These regulations require lessees to sever bottom-founded structures and their related components at least 5 m (15 ft) below the mudline to ensure that nothing would be exposed that could interfere with future lessees and other activities in the area.

In 2008, this Agency conducted an Alternative Internal Control Review of idle structures and wells on active leases on the Gulf of Mexico OCS. This review evaluated the presence of idle infrastructure and a process of identifying, tracking, and decommissioning idle wells and structures. Findings indicated that there are a significant number of idle platforms that have not been removed and idle wells that have not been permanently plugged. Idle infrastructure poses a potential threat to the OCS environment and is a financial liability to operators and the Federal Government if it is subsequently destroyed or damaged in a future event, such as a hurricane. The cost and time to permanently plug wells and remove storm-damaged infrastructure (including pipelines) is significantly higher than decommissioning assets that are not damaged when decommissioned. Increased costs to deal with idle but damaged infrastructure has potential ramifications on the operators' financial security requirements to operate on the OCS or even their financial viability.

On September 15, 2010, BOEMRE launched plans to clear the GOM of "idle iron;" requiring companies to dismantle deserted platforms and permanently plug thousands of abandoned oil and gas wells, including some that are decades old (Dloughy, 2010). The mandate will affect nearly 3,500 nonproducing wells and require the decommissioning of about 650 unused oil and gas production platforms. The new NTL 2010-G05, "Decommissioning Guidance for Wells and Platforms," effective on October 15, 2010, clarifies the operator's procedures for abandoning platforms and wells.

As per 30 CFR 250.1725 (with guidance from NTL 2010-G05),, the decommissioning and removal of infrastructure and the plugging and abandoning of nonproducing wells was required within a year after an operator's offshore oil and gas lease expired. Historically, that policy gave companies plenty of time and freedom to use once-abandoned platforms and other infrastructure to support future wells and other projects. The NTL 2010-G05 explains the approach to ensure that idle infrastructure on active leases is decommissioned in a timely manner. It also provides definitions for the following: (1) capable of production in paying quantities; (2) downhole zonal isolation; (3) no longer useful for operations; and (4) toppled platform. The NTL also clarifies, describes, and interprets many other issues regarding decommissioning that have arisen since publication of 30 CFR 250 Subpart Q in 2002. The NTL 2010-G05 now clarifies the regulations that require the operator to plug any well that has been idle for the past 5 years, along with any associated platforms and pipelines serving it, even if they are part of an active offshore lease.

A well that is no longer useful for operations is defined as one that

- has not been used in the past 5 years for operations associated with the exploration for or the development and production of oil, gas, sulphur, or other mineral resource or as infrastructure to support such operations; and
- has no plans for operations associated with the exploration for or the development and production of oil or gas, or as infrastructure to support such operations.

A platform or structure that is no longer useful for operations is defined as one that

- has been toppled or otherwise destroyed; or
- has not been used in the past 5 years for operations associated with the exploration for or the development and production of oil or gas, sulfur, or other mineral resource or as infrastructure to support such operations.

Programmatic Environmental Assessment

This Agency prepared *Structure-Removal Operations on the Gulf of Mexico Outer Continental Shelf: Programmatic Environmental Assessment* (Programmatic EA) (USDOI, MMS, 2005) to evaluate the full range of potential environmental impacts of structure-removal activities in all water depths in the CPA and WPA and in the areas of the EPA then open for leasing. The activities analyzed in the Programmatic EA include vessel and equipment mobilization, structure preparation, nonexplosive- and explosive-severance activities, post-severance lifting and salvage, and site-clearance verification. The impact-producing factors of structure removals considered in the Programmatic EA include seafloor disturbances, air emissions, water discharges, pressure and acoustic energy from explosive detonations, and space-use conflicts with other OCS users. No potentially significant impacts were identified for air and water quality; marine mammals and sea turtles; fish, benthic communities, and archaeological resources; or other OCS pipeline, navigation, and military uses.

On the basis of the Programmatic EA, this Agency determined that an EIS was not required and prepared a Finding of No Significant Impact on February 15, 2005. On February 28, 2005, this Agency submitted the new structure-removal Programmatic EA and a petition for new Incidental-Take Regulations under the MMPA to NMFS. After review of the petition and Programmatic EA, NMFS published a Notice of Receipt of the Agency's Petition in the *Federal Register* on August 24, 2005. Only one comment was received by NMFS during the public comment period. On April 7, 2006, NMFS published the Proposed MMPA Rule for the Incidental Take of marine mammals in the *Federal Register* and the subsequent public comment period ended May 22, 2006. In addition, NMFS conducted a Section 7 ESA Consultation on their MMPA rulemaking efforts. The consultation was completed and this Agency received a new Biological Opinion and Incidental Take Statement (ITS) on August 28, 2006, which superseded the previous "generic" and "de-minimus" Biological Opinions/ITS's. On June 19, 2008, NMFS finalized their MMPA rulemaking efforts and published the Final Rule for take-regulations for explosive severance, which are located in Subpart S of the MMPA regulations at 50 CFR 216.211-219.

Removal of Bottom Debris

Chapter 4.1.1.3.3.4 of the Multisale EIS and Chapter 3.1.1.6 of the 2009-2012 Supplemental EIS discuss bottom debris, which is defined as material resting on the seabed (such as cable, tools, pipe, drums, anchors, and structural parts of platforms, as well as objects made of plastic, aluminum, wood, etc.) that are accidentally lost (e.g., during hurricanes) or swept overboard from fixed or floating facilities. The maximum quantity of bottom debris per operation is estimated to be several tons. The BOEMRE requires site clearance over the assumed areal extent over which debris will fall. It is assumed that lost debris will be removed from the seafloor during the structure decommissioning, site clearance, and verification process.

Explosive and Nonexplosive Removals

A varied assortment of severing devices and methodologies has been designed to cut structural targets during the course of decommissioning activities. These devices are generally grouped and classified as either nonexplosive or explosive. Which severing tool the operators and contractors use takes into consideration the target size and type, water depth, economics, environmental concerns, tool availability, and weather conditions. The BOEMRE anticipates that multiple appurtenances will not be removed from the seafloor if placed in waters exceeding 800 m (2,625 ft). No explosive removals are projected in water depths >800 m (2,625 ft) because OCS regulations would offer the lessees in those water depths the option to avoid any severance/removal work by requesting alternate removal depths for well abandonments (30 CFR 250.1716(b)(3)) and facilities (30 CFR 250.1728(b)(3)). Above mudline cuts would be allowed with reporting requirements on the remnant's description and height off of the seafloor to BOEMRE. These data are necessary for subsequent reporting to the U.S. Navy. In most cases, industry has indicated that it would use the alternate removal depth options, coupled with quick-disconnect equipment (i.e., detachable risers, mooring disconnect systems, etc.) to fully abandon in-place wellheads, casings, and other minor, subsea equipment in deep water without the need for any severing devices.

WPA Proposed Action Scenario: **Table 3-2** reports platform removals by water-depth range as a result of the WPA proposed action. Of the 19-33 total production structures estimated to be removed as a result of the WPA proposed action, 10-18 production structures (installed landward of the 800-m [2,625-ft] isobath) are likely to be removed using explosives.

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS. Table 4-4 of the Multisale EIS reports that the number of production structures estimated to be removed during the years 2007-2046 is about twice the number of production structures estimated to be installed during the same time period.

3.1.2. Coastal Impact-Producing Factors and Scenario

Chapter 4.1.2 of the Multisale EIS and Chapter 3.1.2 of the 2009-2012 Supplemental EIS describe the coastal impacting factors arising from OCS-related infrastructure and its use during a proposed action in the GOM. The discussion in this Supplemental EIS tiers from the discussion in the Multisale EIS and the 2009-2012 Supplemental EIS.

Coastal impacting factors include (1) service bases and navigation channels, (2) gas processing plants, (3) coastal pipelines, and (4) disposal facilities for offshore operations. The Multisale EIS also discussed topical headings of helicopter hubs, construction facilities, terminals, and coastal barging. These elements of OCS-related infrastructure as coastal impacting factors have not appreciably changed since the 2009-2012 Supplemental EIS and those discussions are hereby incorporated by reference into this Supplemental EIS.

Chapter 4.1.2.1 of the Multisale EIS and Chapter 3.1.2 of the 2009-2012 Supplemental EIS describe the potential need for construction of new facilities and existing facility expansions that may result from a proposed lease sale and the OCS Program. Projected new coastal infrastructure as a result of the OCS Program is shown by State in Table 4-9 of the Multisale EIS. The following information summarizes the scenario analysis incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS and provides new information collected since these documents were prepared.

The BOEMRE has reexamined the scenario analysis presented in the Multisale EIS and in the 2009-2012 Supplemental EIS in light of the DWH event. To date, there has been an influx of much new information related to the oil spill. However, it is too early to determine conclusively whether or not the scenario analysis should be modified, and if it were, what these changes would encompass. **Chapter 4.1** addresses incomplete or unavailable information, including that related to or as a result of the DWH event. The presence of coastal infrastructure is not subject to rapid fluctuations. Infrastructure projections reflect long-term industry trends, and changes to these trends cannot be determined from the few months of post-DWH data that are available and more complete data could be years away. While changes (if any) to the current scenario analysis due to the DWH event and its aftermath are not expected, BOEMRE will continue to collect new data and to monitoring of changes in infrastructure demands in order to support scenario projections that reflect current and future industry conditions.

According to the scenario analysis in Chapter 4.1.2.1.4.2 of the Multisale EIS and in Chapter 3.1.2.2 of the 2009-2012 Supplemental EIS, the construction of 0-1 new gas processing facilities would be expected to occur near the end of the 40-year life of a single lease sale. As described in Chapter 4.1.2.1.4.1 of the Multisale EIS, no new oil refineries are expected to be constructed as a result of a WPA proposed action. Most of the projected new pipelines would be offshore and would tie into the existing offshore pipeline infrastructure, with 0-1 new pipeline landfalls expected to occur toward the end of the 40-year lifespan of a lease sale. The lingering effects of the drilling suspension, changes in Federal requirements for drilling safety, and the current pace in the permit approval process has depressed the demand for gas processing facilities and pipeline landfalls. Given this uncertain environment post-DWH, the application of the Multisale EIS scenario to the WPA proposed action is very conservative; that is, the likelihood is diminished that any new gas processing facility or pipeline landfall would result from a single lease sale and, hence, the likelihood of new facilities or pipeline landfalls has moved closer to zero and farther from one (Dismukes, official communication, 2010a). Maintenance dredging of existing navigation channels is still expected, but no new navigation channels are expected to be dredged as a result of the proposed action. The analyses of coastal infrastructure presented in the Multisale EIS concluded that no new solid-waste facilities would be built as a result of a single lease sale or as a result of the OCS Program. Recent research further supports these past conclusions that existing solid-waste disposal infrastructure is adequate to support both existing and projected offshore oil and gas drilling and production needs. The volume of OCS waste generated is closely correlated with the level of offshore drilling and production activity. Demand for waste disposal facilities is influenced by the volume of waste generated (Dismukes et al., 2007). At this time, it is unclear how long the current pace of activity will continue or how it might affect later years. Until OCS drilling activity recovers, the potential for a new waste facility as a result of the proposed action is highly unlikely; however, such a conclusion remains tentative at this early date post-DWH. As such, this scenario continues to consider a new waste facility unlikely, but possible.

The source of the majority of the information on coastal infrastructure and activities presented in the Multisale EIS is this Agency's study, *OCS-Related Infrastructure in the Gulf of Mexico Fact Book* (The Louis Berger Group, Inc., 2004). An update of this fact book, *OCS-Related Infrastructure Fact Book: Post-Hurricane Impact Assessment (Volume I)* and *Communities in the Gulf of Mexico (Volume II)*, is nearly complete (Dismukes, in preparation-a). Within the last 3 years, this Agency analyzed historical data and validated past scenario projections of new pipeline landfalls and new onshore waste disposal sites (USDOI, MMS, 2007a and 2007b).

The following coastal infrastructure types are highlighted for discussion because new general information is available, new facilities are projected to be constructed as a result of the proposed action, and/or new information relevant to discussions of the DWH event is available.

3.1.2.1. Service Bases

Chapter 4.1.2.1 of the Multisale EIS and Chapter 3.1.2.1 of the 2009-2012 Supplemental EIS describe the coastal impacting factors arising from service bases in the GOM. A service base is a community of businesses that load, store, and supply equipment, supplies, and personnel that are needed at offshore work sites. Chapters 3.3.5.8.1 and 4.1.2.1.1 of the Multisale EIS present a detailed description of OCS-related service bases. While no proposed action is projected to significantly change existing OCS-related service bases or require any additional service bases, a proposed action would contribute to the use of existing service bases. **Figure 3-4** shows the 50 service bases the industry currently uses to service the OCS. These facilities were identified as the primary service bases from plans received by BOEMRE. The ports of Fourchon, Cameron, Venice, and Morgan City, Louisiana, are the primary service bases for GOM mobile rigs. Major platform service bases are Galveston, Freeport, and Port O'Connor, Texas; Cameron, Fourchon, Intracoastal City, Morgan City, and Venice, Louisiana; Pascagoula, Mississippi; and Theodore, Alabama.

Exploration and development plans received by BOEMRE identify primary and secondary service bases for three types of support: supply vessel; crewboat; and helicopter. Supply vessel bases are loading points and provide temporary storage for supply vessels that transport pipe and bulk supplies. Crewboats transport personnel and small supplies. Collectively, supply vessels and crewboats are known as offshore supply vessels (OSV's). Approximately 1,200 OSV's are operating in the GOM. Important drivers for the OSV market include the level of offshore exploration and drilling activities, current oil and gas prices, expectations for future oil and gas prices, and customer assessments of offshore prospects (Dismukes, in preparation-b). Helicopters transport personnel and small supplies, and they may also patrol pipelines to spot signs of damage or leakage. Helicopters service drilling rigs, production platforms, and pipeline terminals, as well as specialized vessels such as jack-up barges. The OCS activity levels and offshore oil and gas industry transportation needs substantially influence the demand for and profitability of helicopter services (Dismukes, in preparation-b). A service base may support one or more of these activities, while an offshore facility may utilize one service base for all three uses or different service bases for each. Because of changing weather or operational conditions, small amounts of vessel and helicopter traffic may be dispatched from alternative bases. However, such shifts are expected to be only temporary and vessel traffic and helicopter transport generally returns to primary and secondary bases as soon as possible.

As OCS operations have progressively moved into deeper waters, larger vessels with deeper drafts have been phased into service, mainly for their greater range, faster speed, and larger carrying capacity. Service bases with the greatest appeal for deepwater activity have several common characteristics: strong and reliable transportation systems; adequate depth and width of navigation channels; adequate port facilities; existing petroleum industry support infrastructure; location central to OCS deepwater activities;

adequate worker population within commuting distance; and insightful strong leadership. Typically, deeper draft service vessels require channels with depths of 20-26 ft (6-8 m).

Port Fourchon is usually the primary service base identified in exploration and development plans for deepwater activities; however, some operator plans identify other bases instead of Port Fourchon for either crew or helicopter use, or as a backup to Port Fourchon. Because of the limited amount of land available at Port Fourchon, the port may face boat docking capacity constraints in the long term. Operators looking to diversify risk from shutdowns (such as those shutdowns after major hurricanes) are also likely to look to other ports. However, increased activity in the WPA, such as the Walker Ridge lower Tertiary plays, could signal potential increased demand in the future for a second Port Fourchon-type facility somewhere along the Texas coast, possibly near Corpus Christi (Dismukes, official communication, 2010b). The Agency-funded study, *OCS-Related Infrastructure Fact Book: Post-Hurricane Impact Assessment (Volume I)* and *Communities in the Gulf of Mexico (Volume II)* (Dismukes, in preparation-a), should be published in 2011 and includes an in-depth hurricane impact analysis for each type of coastal infrastructure.

WPA Proposed Action Scenario: The proposed action contributes to the continued need for maintenance of existing service bases. However, no new service bases are expected to develop as a direct result of the WPA proposed action.

OCS Program Scenario: Newer geologic trends being exploited by today's operators may lead to development of capability or the relocation of facilities to a new service base along the Texas Gulf Coast during the years 2007-2046.

Navigation Channels

Chapter 4.1.2.9 of the Multisale EIS and Chapter 3.1.2.1 of the 2009-2012 Supplemental EIS describe the coastal impacting factors arising from navigation channels in the GOM. Navigation channels undergo maintenance dredging that is essential for sustaining proper water depths to allow ships to move safely through the waterways to ports, services bases, and terminal facilities. In the northern GOM, the existing system of navigation channels is projected to be adequate to allow proper accommodation for vessel traffic that will occur as a result of a single proposed action. The Gulf-to-port channels and the Gulf Intracoastal Waterway (GIWW) that support prospective OCS ports are maintained by regular dredging and are generally sufficiently deep and wide to handle OCS-related traffic (**Figure 3-5**). The COE is the Federal agency responsible for the regulation and oversight of navigable waterways. The maintained depth for each waterway is shown in Table 3-36 of the Multisale EIS. All single lease sales contribute to the level of demand for offshore supply vessel support; hence, they also contribute to the level of vessel traffic that travels through the navigation channels to support facilities. While maintenance dredging is essential for vessels to safely reach support facilities, it is a controversial process because it necessarily occurs in or near environmentally sensitive areas such as valuable wetlands, estuaries, and fisheries (Dismukes, in preparation-b).

WPA Proposed Action Scenario: The proposed action contributes to the continued need for maintenance dredging of existing navigation channels. However, no additional maintenance dredging is expected to be scheduled or new navigation channels are expected to be constructed as a direct result of the WPA proposed action.

OCS Program Scenario: There is no current expectation for new navigation channels to be authorized and constructed during the years 2007-2046 as a direct result of the OCS Program. One major Federal channel, the Mississippi River Gulf Outlet, was taken out of service and sealed with a rock dike in 2009.

3.1.2.2. Gas Processing Plants

Chapter 4.1.2.1.4.2 of the Multisale EIS and Chapter 3.1.2.2 of the 2009-2012 Supplemental EIS describe the coastal impacting factors arising from gas processing plants and the potential for new facilities and/or expansion at existing facilities in the GOM. As of July 1, 2011, there were 94 OCS-related gas processing plants in the BOEMRE-identified 13 EIA's along the Gulf Coast (Dismukes, in preparation-a).

Over the past 5 years, there has been a substantial decrease in offshore natural gas production, partially as a result of increasing emphasis on onshore shale gas development, which is less expensive to produce, is closer to consumption sources, and provides larger per well production opportunities and reserve growth. Also, there has been a trend toward more efficient gas processing facilities with greater processing capacities (Dismukes, official communication, 2010c). For example, in Texas the average daily processing capacity per plant has increased from 66 MMcf to 95 MMcf between 1995 and 2004 (USDOE, Energy Information Administration, 2006, p. 6). While natural gas production on the OCS shelf (shallow water) has been rapidly declining, deepwater gas production has been increasing, but not quickly enough to make up the difference. Increasing onshore shale gas development, declining offshore gas production, and the increasing efficiency and capacity of existing gas processing facilities are trends that have combined to lower the need for new gas processing facilities along the Gulf Coast in the past 5 years. Combined with this, existing facilities that were already operating at about 50 percent of capacity prior to the 2005 hurricane season are operating at even lower capacity utilization levels now. Spare capacity at existing facilities should be sufficient to satisfy new gas production for many years, although there remains a slim chance that a new gas processing facility may be needed by the end of the 40-year life of the proposed action (Dismukes, official communication, 2010c).

WPA Proposed Action Scenario: The BOEMRE projects that 0-1 new gas processing facility may be constructed as a result of the WPA proposed action. However, the likelihood of a new gas processing facility has moved closer to zero and farther from one (Dismukes, official communication, 2010c).

OCS Program Scenario: Expectations for new gas processing facilities being built during the period 2007-2046 as a direct result of the OCS Program are dependent on long-term market trends that are not easily predicable over the next 40 years. Existing facilities will experience equipment switch-outs or upgrades during this time.

3.1.2.3. Coastal Pipelines

Chapters 3.3.5.8.8 and 4.1.2.1.7 of the Multisale EIS and Chapter 3.1.2.2 of the 2009-2012 Supplemental EIS describe the coastal impacting factors arising from OCS pipelines in coastal waters (State offshore and inland waters) and coastal onshore areas. The OCS pipelines near shore and onshore may join pipelines carrying production from State waters or territories for transport to processing facilities or to distribution pipelines located farther inland. In the Multisale EIS, this Agency assumed that the majority of new Federal OCS pipelines would connect to the existing pipelines in Federal and State waters and that very few would result in new pipeline landfalls. Therefore, this Agency projected 0-1 pipeline landfalls per lease sale (USDOI, MMS, 2007b). Between the Multisale EIS and the 2009-2012 Supplemental EIS, this Agency tested this assumption by analyzing past lease sale outcomes and determined that it is unlikely that even one pipeline landfall will result from an individual proposed action (USDOI, MMS, 2007d). Oil and gas companies have a strong financial incentive to reduce costs by utilizing the existing mature pipeline network that already exists in the GOM to the fullest extent possible. Economies of scale are a factor in pipeline transportation, and maximization of the amount of product moved through an already existing pipeline decreases the long-term average cost of production. Additional considerations include mitigation costs for any new wetland and environmental impacts and various landowner issues at the landfall point. These are strong incentives to move new production into existing systems and to avoid creating new landfalls (Chapter 4.1.2.1.7 of the Multisale EIS). Therefore, BOEMRE projects that the majority of new pipelines constructed as a result of a WPA proposed action would connect to the existing pipeline infrastructure. In the rare instance that a new pipeline would need to be constructed, it will likely be because there are no existing pipelines reasonably close and it is more cost effective to construct a pipeline to shore; although for an operator to choose this contingency is thought to be highly unlikely (Dismukes, official communication, 2010d).

WPA Proposed Action Scenario: The Multisale EIS and the 2009-2012 Supplemental EIS project that 0-1 new landfalls are projected for a WPA proposed action. This scenario projection stands, although the likelihood of a new pipeline landfall has moved closer to zero and farther from one (Dismukes, official communication, 2010a).

OCS Program Scenario: The Multisale EIS projected that from 2007 to 2046, 80-118 new pipelines were projected to be built in State waters as a result of the OCS Program. Of those pipelines, 32-47 were projected to make landfall. However, the reassessment of this scenario between the Multisale EIS and the 2009-2012 Supplemental EIS resulted in a more conservative projection that even one pipeline landfall as a result of each lease sale during the OCS Program is unlikely (USDOI, MMS, 2007d). Therefore, the

OCS Program from 2007 to 2046 is unlikely to result in more than 11 new pipeline landfalls (see also **Chapter 3.1.1.4.1**).

3.1.2.4. Disposal Facilities for Offshore Operations

Chapters 3.3.5.8.7 and 4.1.2.1.6 of the Multisale EIS and Chapter 3.1.2.4 of the 2009-2012 Supplemental EIS describe the coastal impacting factors arising from the infrastructure network needed to manage the spectrum of waste generated by OCS activity and disposal onshore in the GOM. The analyses of coastal infrastructure presented in the Multisale EIS concluded that no new solid-waste facilities would be built as a result of a single lease sale or as a result of the OCS Program. Between the Multisale EIS and the 2009-2012 Supplemental EIS additional research was conducted that further supports past conclusions that existing solid-waste disposal infrastructure is adequate to support both existing and projected offshore oil and gas drilling and production needs (Dismukes et al., 2007). Recently, there is a trend toward incorporating more innovative methods for waste handling in an attempt to reduce the chance of adverse environmental impacts. Some of these innovative methods include hydrocarbon recovery/recycling programs, slurry fracture injection, treating wastes for re-use as road base or levee fill, and segregating waste streams to reduce treatment time and improve oil recovery (Dismukes, in preparation-a).

Before the DWH event, this Agency's analyses indicated that there was an abundance of solid-waste capacity in the GOM region and, thus, it is highly unlikely that any new waste facilities would be constructed. Recent research shows that the volume of OCS waste generated is closely correlated with the level of offshore drilling and production activity (Dismukes, in preparation-a). If offshore activities increase to the extent that a need for more capacity develops, it will probably be met by expansion of existing facilities. However, it is now unclear whether this will remain true; therefore, more research is needed (Dismukes, official communication, 2010e). Due to the temporary suspension (no longer in effect) on deepwater drilling, there has been some reduction in offshore drilling activity. Given this situation, the demand for waste disposal facilities may not be likely to increase. However, at this time, BOEMRE cannot predict how long this temporary interruption will continue or how long it will take for activity levels to recover. Since there is not enough information at this time to draw a solid conclusion, BOEMRE will continue to monitor waste disposal demands and activity in the post-DWH environment. **Chapter 4.1.1.18.4.2** provides a discussion of environmental justice issues related to waste disposal facilities.

WPA Proposed Action Scenario: Existing onshore facilities will continue to be used to dispose of wastes generated offshore. However, no new disposal facilities are expected to be licensed as a direct result of the proposed action.

OCS Program Scenario: There is no current expectation for new onshore waste disposal facilities to be authorized and constructed during the 2007-2046 period as a direct result of the OCS Program. Existing facilities are likely to undergo expansion, but no definitive projections can be made.

Summary

In response to the DWH event, BOEMRE has reexamined the scenario analysis presented in the Multisale EIS and in the 2009-2012 Supplemental EIS. According to the scenario analysis in the 2009-2012 Supplemental EIS, the construction of 0-1 new gas processing facilities and 0-1 new pipeline landfalls would be expected to occur near the end of the 40-year life of a single lease sale. Given the uncertain environment post-DWH, the WPA proposed action is very conservative since the likelihood is diminished further that any new gas processing facility or pipeline landfall would result from a single lease sale (Dismukes, official communication, 2010a). New information on the DWH event continues to be developed. The BOEMRE recognizes the need for, and is currently conducting continuous monitoring of, changes in infrastructure demands in order to adequately determine scenario projections for current and future environmental assessments.

3.2. IMPACT-PRODUCING FACTORS AND SCENARIO—ACCIDENTAL EVENTS

The NEPA requires Federal agencies to consider potential environmental impacts of a proposed action as part of agency planning and decisionmaking. Actions that could result in impact are analyzed;

including those that have a very low probability of occurring, but that the public considers important, are controversial, or may have severe consequences. The accidental events that fall into this category and that are addressed in this section are (1) oil spills, (2) losses of well control, (3) pipeline failures, (4) vessel collisions, and (5) chemical or drilling fluid spills.

The OCS Program pollution-prevention requirements include features such as redundant safety systems, and periodic inspection and testing protocols. Although the likelihood for spills of the magnitude of the DWH event are rare, when they do occur, the affects on physical, biological, and socioeconomic resources can be dramatic and potentially severe.

3.2.1. Oil Spills

Oil spills are unplanned, accidental events but their potential frequency and volume can be estimated from past occurrences. Chapter 4.3.1 of the Multisale EIS analyzes the risk of spills that could occur as a result of activities associated with a WPA proposed action. Chapter 4.3.1.1 of the Multisale EIS discusses spill prevention.

Chapter 4.3.1.2 of the Multisale EIS provides an overview of spill risk analysis including more information about the inputs to the spill scenario and the trajectory and weathering modeling. Chapter 4.3.1.3 of the Multisale EIS discusses past OCS spills. Oil also enters the GOM by pathways and sources other than spills, including natural seeps, permitted discharges, and sources related to human activities; these are discussed in Chapter 4.1.3.4 of the Multisale EIS and in **Chapter 3.1.1.3** of this Supplemental EIS.

Chapter 4.3.1.4 of the Multisale EIS discusses the physical and chemical properties of oil. The properties of the spilled oil can influence the persistence of the spill on the water's surface and the success of spill cleanup efforts. The fate of oil in the environment depends on many factors, such as the source and composition of the oil, as well as its persistence (NRC, 2003). Persistence can be defined and measured in different ways (Davis et al., 2004), but the National Research Council generally defined persistence as how long oil remains in the environment (NRC, 2003, p. 89). Once oil enters the environment, it begins to change through physical, chemical, and biological weathering processes (NRC, 2003). These processes may interact and affect the properties and persistence of the oil, including the following:

- evaporation (volatilization);
- emulsification (the formation of a mousse);
- dissolution;
- oxidation; and
- transport processes (NRC, 2003; Scholz et al., 1999).

Horizontal transport takes place via spreading, advection, dispersion, and entrainment while vertical transport takes place via dispersion, entrainment, Langmuir circulation, sinking, overwashing, partitioning, and sedimentation (NRC, 2003). The persistence of an oil slick is influenced by the effectiveness of oil-spill-response efforts and affects the resources needed for oil recovery (Davis et al., 2004). The persistence of an oil slick may also affect the severity of environmental impacts.

Crude oils are not a single chemical, but instead are complex mixtures with varied compositions. Thus, the behavior of the oil and the risk the oil poses to natural resources depends on the composition of the specific oil encountered (Michel, 1992). Generally, oils can be divided into three groups of compounds: (1) light-weight; (2) medium-weight; and (3) heavy-weight components.

Of the oil reservoirs sampled in the Gulf of Mexico OCS, the majority fall within the light-weight category, while less than one-quarter are considered medium-weight and a small portion are considered heavy-weight. Oil with an API gravity of 10.0 or less would sink and has not been encountered in the Gulf of Mexico OCS (USDOI, BOEMRE, 2010c).

Heavy-weight oil may persist in the environment longer than the other two types of oil, but the medium-weight components within oil present the greatest risks to organisms because, with the exception of the alkanes, these medium-weight components are persistent, bioavailable, and toxic (Michel, 1992).

An experiment in the North Sea, Deep Spill, indicated that the majority of oil released during a deepwater blowout would quickly rise to the surface and form a slick (Johansen et al., 2001). In such a case, impacts from a deepwater oil spill would occur at the surface where the oil is likely to be mixed into the water and dispersed by wind and waves. The oil would undergo natural physical, chemical, and biological degradation processes including weathering. However, data and observations from the DWH event challenged the previously prevailing thought that most oil from a deepwater blowout would quickly rise to the surface. While analyses are in their preliminary stages, it appears that measurable amounts of hydrocarbons (dispersed or otherwise) were detected in the water column as subsurface plumes (**Chapter 4.2.1.2.2.1**) and perhaps on the seafloor in the vicinity of the release. After the *Ixtoc* blowout in 1979, which was located 50 mi (80 km) offshore in the Bay of Campeche, Mexico, some subsurface oil also was observed dispersed within the water column (Boehm and Fiest, 1982); however, the scientific investigations were limited (Reible, 2010).

As spill size increases, the occurrence rate decreases and so does the number of spills estimated to occur (**Table 3-5**) (also see Anderson and LaBelle, 2000). In general terms, coastal waters adjacent to the WPA are expected to be impacted by many frequent small spills (≤1 bbl); few, infrequent, moderately-sized spills (>1 and <1,000 bbl); and rarely a large spill (≥1,000 bbl) as a result of activities associated with the WPA proposed action.

The following discussion provides separate risk information for offshore spills ≥1,000 bbl, offshore spills <1,000 bbl, and coastal spills that may result from the proposed action.

Past Spill Projections and Future Trends

Comments on prior EIS's questioned the validation between the actual number of spills that resulted from a proposed lease sale to the projected number of spills in the NEPA document. This Agency has not performed this validation. When spills are reported to USCG, the location of the spill, the type of vessel, and the volume and the material spilled is identified. The USCG does not attribute a spill back to a BOEMRE lease sale. More information is available about the larger spills than the small spills, and some of them can be matched with a particular lease sale. In other cases, it is more difficult to nearly impossible to link a spill to a lease sale because, for example, a fuel spill could occur from a vessel that services multiple facilities leased during different sales, or a pipeline spill could release oil combined from multiple production locations that were leased during different sales. Many of the small spills do not have a known source and so cannot be linked to a lease sale. An attempt was made in Canada to determine the accuracy of the predicted oil spills from several projects (Fraser and Ellis, 2008). In their investigation of spills of <50 bbl from projects in Nova Scotia and Newfoundland, they found that predicted spills underestimated the number of observed spills.

The U.S. consumption of oil is predicted to rise. The percentage of oil imported has been rising over time. Most imports, with the exception of Canadian oil, are transported by vessel. Fifty-three percent of oil imports, the majority as crude oil, arrive via the Gulf Coast (Ramseur, 2010). Nationally, of the oil spills in coastal and marine areas that are within USCG jurisdiction, 50 percent of both the incidents and the volume spilled occur in the GOM and its shoreline states, making the Gulf Coast an area of concentrated use.

3.2.1.1. Risk Analysis for Offshore Spills ≥1,000 bbl

Methods

Chapter 4.3.1.5 of the Multisale EIS addresses the risk of offshore spills ≥1,000 bbl that could occur from accidents associated with activities resulting from a proposed action. Spill rates (Table 4-16 of the Multisale EIS) were calculated based on the assumption that spills occur in direct proportion to the volume of oil handled and are expressed as number of spills per billion barrels of oil handled. Anderson and LaBelle (2000) provide more information on OCS spill-rate methodologies and trends. A discussion of how the range of resource estimates was developed is provided in Chapter 4.1.1.1 of the Multisale EIS and in **Chapter 3.1.1** of this Supplemental EIS. In addition, BOEMRE is in the process of updating these spill rates, which will include the recent DWH event; however, significant changes to the spill rates for the entire OCS are not anticipated (Anderson, official communication, 2010).

The mean number of future offshore spills ≥1,000 bbl is calculated by multiplying the spill occurrence rate for spills ≥1,000 bbl (1.51) by the volume of oil estimated to be produced as a result of the proposed action (Anderson and LaBelle, 2000). The median size of spills ≥1,000 bbl that occurred during 1985-1999 is 4,551 bbl, and the median size for spills ≥10,000 bbl is 15,000 bbl (Table 4-16 of the Multisale EIS).

Estimates of Spill Numbers

As shown on **Table 3-5,** the mean number of spills estimated for the WPA proposed action is <1 to 1 spill.

Fate

Offshore spills ≥1,000 bbl are the most likely to persist long enough on the water's surface to impact the shoreline. The fate of an oil spill is influenced by many variables. Aspects that influence spill persistence are discussed in Chapter 4.3.2.5.4 of the Multisale EIS and in **Chapter 3.2.1** of this Supplemental EIS, as related to oil type, and they are summarized below (see also **Table 3-6**).

Table 4-37 of the Multisale EIS provide a mass balance over time for a hypothetical spill related to a WPA proposed action, which is considered in this Supplemental EIS. Weathering processes include evaporation of volatile hydrocarbons into the atmosphere, dissolution of soluble components, dispersion of oil droplets into the water column, emulsification and spreading of the slick on the surface of the water, chemo- or photooxidation, biodegradation, and in some cases sedimentation (sinking) (ITOPF, 2010a; NRC, 2003).

Over time, if the slick is not completely dissipated, a tar-like residue may be left; this residue breaks up into smaller tar lumps or tarballs that usually sink below the sea surface but not necessarily to the seafloor. Not all oils form tarballs.

The BOEMRE used the SINTEF model to numerically model weathering processes (Prentki et al., 2004). Model results from the SINTEF weathering model for the WPA are presented in Table 4-37 of the Multisale EIS.

Movement into the deep waters of the Gulf of Mexico increasingly relies on subsea production infrastructure, possibly increasing the risk of seafloor releases. As noted in **Chapter 3.2.1**, the behavior of a spill depends on many things, including the characteristics of the oil being spilled as well as oceanographic and meteorological conditions. An experiment in the North Sea indicated that the majority of oil released during a deepwater blowout would quickly rise to the surface and form a slick (Johansen et al., 2001). In such a case, impacts from a deepwater oil spill would occur at the surface where the oil is likely to be mixed into the water and dispersed by wind and waves. The oil would undergo natural physical, chemical, and biological degradation processes including weathering. However, data and observations from the DWH event challenged the previously prevailing thought that most oil from a deepwater blowout would quickly rise to the surface. While analyses are in their preliminary stages, it appears that measurable amounts of hydrocarbons (dispersed or otherwise) were detected in the water column as subsurface plumes (**Chapter 4.2.1.2.2.1**) and perhaps on the seafloor in the vicinity of the release. After the *Ixtoc* blowout in 1979, which was located 50 mi (80 km) offshore in the Bay of Campeche, Mexico, some subsurface oil also was observed dispersed within the water column (Boehm and Fiest, 1982); however, the scientific investigations were limited (Reible, 2010). The water quality of marine waters would be affected by the dissolved components and oil droplets that are small enough so that they do not rise to the surface or are mixed downward by surface turbulence. Subsurface oil plumes would be affected by subsurface currents and could be diluted over time. Even in the subsurface, oil would undergo natural physical, chemical, and biological degradation processes including weathering.

Chapter 4.3.1.5.6 of the Multisale EIS provides an estimate of the length of coastline affected by offshore spills ≥1,000 bbl. The maximum length of shoreline affected by a representative spill ≥1,000 bbl is estimated to be 30-50 km (19-31 mi) of shoreline, assuming such a spill were to reach land within 12 hours (Table 4-37 of the Multisale EIS). Some oil could become redistributed because of longshore currents, and further smearing of the slick from its original landfall could also occur.

Likelihood of Occurring and Contacting Environmental Resources

The BOEMRE uses the Oil Spill Risk Analysis (OSRA) model to estimate the likely trajectories of hypothetical offshore spills ≥1,000 bbl. The trajectories, combined with estimated spill occurrence, are used to estimate the risk of future spills occurring and contacting environmental features. Chapter 4.3.1.5.5 of the Multisale EIS briefly summarized the OSRA model, while Ji et al. (2007) provides a detailed description of the OSRA model. The probability of spill occurring as a result of the WPA proposed action and contacting environmental resources of concern is provided in Figures 4-13 through 4-31 of the Multisale EIS.

All proposed GOM sales for the 5-Year Program were considered in the OSRA run for the Multisale EIS. The scenario for the WPA proposed action in this Supplemental EIS, the last WPA sale in the 5-Year Program, has been revised and is discussed in **Chapter 3.1.1**. A new OSRA run based on just the last WPA proposed lease sale in this Supplemental EIS scenario would not be expected to substantially affect probabilities in comparison with those obtained from the previous OSRA run.

Summary of the Catastrophic Spill OSRA Run

After the DWH event, BOEMRE worked to develop an OSRA model run to adequately assess a hypothetical oil spill that spills continuously at a fixed rate from an assigned location over an assigned duration. Preliminary model runs were conducted to track oil-spill trajectories for 90 days in order to simulate a long-duration spill from a given point. The model tracked the oil-spill trajectories throughout the 90 days (simulated spilling) and stopped the spill after the 90th day to simulate the point at which well control was reestablished and after an additional 30 days after capping to simulate the behavior of oil at sea.

The probability estimates for land contact were tabulated as 90-day groupings corresponding to each quarter of a year (Q1, Q2, Q3, and Q4). These 3-month probabilities can be used to estimate the average number of land segments contacted during a spill event within the designated quarter. The groupings by quarter capture the differences in meteorological and oceanographic conditions in the GOM as they vary over the years from 1993 to 1998 (the most recent GOM data available to BOEMRE). Five launch points were selected for five independent model runs to assess the probably of oil contacting the shoreline from each given hypothetical launch point. The five launch points for the simulated spill corresponded to the following OCS areas in the WPA and CPA:

- LP1—CPA shelf area, west of the Mississippi River Delta, offshore south-central Louisiana, deepwater;
- LP2—CPA shelf edge area, east of the Mississippi River Delta, south of the Alabama-Mississippi border, deepwater;
- LP3—CPA slope area, west of the Mississippi River Delta, due south of New Orleans, ultra-deepwater;
- LP4—WPA shelf area, deepwater; and
- LP5—WPA slope area, ultra-deepwater.

The following first-order results were obtained for a spill of 90 days duration:

- LP1—moderate probability of contacting coastal parishes in south-central Louisiana to counties in north-central Gulf Coast Texas during all quarters of the year, greatest probability in Q3 and Q4;
- LP2—moderate to large probability of contacting Mississippi delta and coastal counties of Alabama and Mississippi in all quarters, greatest probability in Q1, Q2, and Q4;
- LP3—small probability of contacting parishes in east-central Louisiana, greatest probability in Q2;

- LP4—moderately-large probability of contacting the counties of south-central Gulf Coast Texas, greatest probability in Q2; and
- LP5—small probability of a spill contacting the coastal counties of mid-Gulf Coast Texas, greatest probability in Q2.

This exercise is a first of its kind because, although this Agency's OSRA model accounts for an instantaneous spill, it was not designed specifically to model a spill over a given duration. This approach is still under review and development. Preliminary model runs were conducted and only preliminary data are currently available; however, this effort will continue to be developed and advanced to ensure that the most conservative estimates of environmental impacts are available and that all impacts are disclosed. **Appendix C** contains a greater explanation of the catastrophic spill OSRA run.

3.2.1.2. Risk Analysis for Offshore Spills <1,000 bbl

A description of accidental events, including offshore spills <1,000 bbl can be found in Chapter 4.3.1.6 of the Multisale EIS and in Chapter 3.2.1.2 of the 2009-2012 Supplemental EIS. The following information describes spills <1,000 bbl. To discuss spills <1,000 bbl, information is broken into size groups, as shown in Table 4-16 of the Multisale EIS.

Analysis of historical data shows that most offshore OCS oil spills have been ≤1 bbl (Figure 4-32 of the Multisale EIS). Although spills of ≤1 bbl have made up 94 percent of all OCS-related spill occurrences, spills of this size have contributed very little (5%) to the total volume of OCS oil that has been spilled. Most of the total volume of OCS oil spilled (95%) has been from spills ≥10 bbl.

The number of offshore spills <1,000 bbl estimated to occur over the next 40 years as a result of the proposed action is provided in **Table 3-5**, which has been updated from Table 4-35 of the Multisale EIS and from Table 3-6 of the 2009-2012 Supplemental EIS. The number of spills is estimated by multiplying the oil-spill rate for each of the different spill size groups by the projected oil production as a result of the proposed action. The number of spills >500 and <1,000 bbl estimated to occur is <1 for the WPA proposed action. In the spill size range of >50-500 bbl, 1-3 spills are estimated to occur from activities related to the WPA proposed action. Multiplying the estimated number of spills by the median or average spill sizes for each size group yields the volume of oil estimated to be spilled as a result of the proposed action over the 40-year analysis period. A total of 400-1,250 bbl of oil is estimated from spills <1,000 bbl in size as a result of the WPA proposed action.

3.2.1.3. Risk Analysis for Coastal Spills

Chapter 4.3.1.7 of the Multisale EIS addresses the risk of coastal spills of all sizes that could occur from accidents associated with activities resulting from a proposed action. Chapter 3.2.1.3 of the 2009-2012 Supplemental EIS provides an update to the Multisale EIS.

Spills in coastal waters could occur as a result of transportation and handling of OCS-produced oil as it passes through State waters and along navigation channels, rivers, and through coastal bays. The BOEMRE projects that almost all (>99%) oil produced in waters <800 ft (244 m) deep as a result of the proposed action will be brought ashore by pipelines, while 50-100 percent of oil produced in waters >800 ft (244 m) deep will be brought ashore by tanker. Because piped oil is commingled at shore bases and cannot be directly attributed to a particular lease sale, this analysis of coastal spills addresses spills that could occur prior to the oil arriving at the initial shoreline facility. It is also possible that non-OCS oil may be commingled with OCS oil at these facilities or during subsequent secondary transport.

The coastal spill rate is based on historical spills and the projected amount of oil production. Because the majority of oil production from the WPA proposed action is projected to be brought to shore in the Galveston/Houston/Texas City area, it is assumed the majority of coastal spills from the WPA proposed action will also occur in this area.

Several USCG resources were used to estimate the number of coastal oil spills attributable to the proposed action, including the USCG Polluting Incident Compendium and data obtained from USCG. The Multisale EIS used a version of the Oil Spill Compendium containing data through 2000, and the 2009-2012 Supplemental EIS used a version of the Oil Spill Compendium containing data through 2004. At present, *Polluting Incidents In and Around U.S. Waters, A Spill/Release Compendium: 1969-2008* is available (U.S. Dept. of Homeland Security, CG, 2010a). The database available from USCG covers through 2008 as well. **Figure 3-6** illustrates, for the year 2008, the location and size range of the spills in both coastal and offshore areas of the WPA.

The number of GOM coastal spills from eight sources associated with State or Federal offshore production and international importation was determined. The sources that were counted are (1) fixed platforms, (2) mobile offshore drilling units, (3) offshore marine facilities, (4) offshore supply/service vessels, (5) offshore pipelines, (6) tank barges, (7) tank ships, and (8) unknown sources. In 2001, a total of 270 spills occurred in coastal GOM, of which roughly half were from the source types associated with State or Federal offshore oil production, oil importation, and unknown sources. All spills of unknown origin were counted as OCS in origin, which would not be the case in reality. Three billion barrels of total oil, including condensate, was transported to shore from Federal and State offshore production and by importation. Federal OCS production comprised 19 percent of the oil transported to the coast and, therefore, is assumed to account for 19 percent of the spills. The amounts of various fuel oils transported for the purpose of consumption are not counted in this volume. Thus, the OCS production spill rate in coastal waters was determined to be in the range of 57-74 spills per billion barrels of oil.

WPA Proposed Action Scenario: The volume of oil production projected has not changed since the Multisale, i.e., 0.222-0.423 BBO. Given an estimated spill rate of 57-74 spills per billion barrels of oil, it is estimated that 15-34 spills of OCS oil will occur in the WPA coastal area (**Table 3-7**).

OCS Program Scenario: The OCS Program scenario remains the same as the originally forecasted program scenario in the Multisale EIS. Table 4-1 of the Multisale EIS shows the estimated range of the volume of oil production projected.

3.2.1.4. Risk Analysis by Resource

Chapter 4.3.1.8 of the Multisale EIS summarizes this Agency's information on the risk to resources from oil spills and oil slicks that could occur as a result of a WPA proposed action. The risk results are based on BOEMRE's estimates of likely spill locations, sources, sizes, frequency of occurrence, and probable transport. For offshore spills, the analysis presents combined probabilities, which include both the likelihood of a spill from the proposed action, as defined in the Multisale EIS, occurring and the likelihood of the oil slick reaching areas where known environmental resources occur. The analysis of the likelihood of direct exposure and interaction of a resource with an oil slick and the sensitivity of a resource to the oil is provided for environmental and socioeconomic resources in **Chapter 4** of this Supplemental EIS. The coastal spill risk is estimated based on the historic spill rate, not a probability (Chapter 4.3.1.7.1 of the Multisale EIS).

3.2.1.5. Spill Response

3.2.1.5.1. BOEMRE Spill-Response Requirements and Initiatives

As a result of the Oil Pollution Act of 1990, BOEMRE was tasked with a number of oil-spill-response duties and planning requirements. According to BOEMRE's regulations at 30 CFR 250 and 254, BOEMRE implements these requirements as follows:

- requires immediate notification for spills >1 bbl—all spills require notification to USCG and BOEMRE receives notification from the USCG of all spills ≤1 bbl;
- conducts investigations to determine the cause of a spill;
- assesses civil and criminal penalties, if needed;
- oversees spill source control and abatement operations by industry;
- sets requirements and reviews and approves oil-spill-response plans for offshore facilities;
- conducts unannounced drills to ensure compliance with oil-spill-response plans;

- requires operators to ensure that their spill-response operating and management teams receive appropriate spill-response training;
- conducts inspections of oil-spill-response equipment;
- requires industry to show financial responsibility to respond to possible spills; and
- provides research leadership to improve the capabilities for detecting and responding to an oil spill in the marine environment.

The BOEMRE also issued NTL's and guidance documents that clarify additional oil-spill requirements after the DWH event occurred. The spill-response-related NTL's and guidance documents issued by BOEMRE include the following NTL's.

NTL 2010-N10 "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources"

This NTL, effective November 8, 2010, applies only to operators conducting operations using subsea or surface BOP's on floating facilities. It explains that lessees and operators submit a statement signed by an authorized company official with each application for a well permit indicating that they will conduct all of their authorized activities in compliance with all applicable regulations, including the Increased Safety Measures Regulations at 75 FR 63346. The NTL also informs lessees that BOEMRE will be evaluating whether or not each operator has submitted adequate information demonstrating that it has access to and can deploy surface and subsea containment resources that would be adequate to promptly respond to a blowout or other loss of well control. The NTL notifies the operator that BOEMRE intends to evaluate the adequacy of each operator to comply in the operator's current OSRP; therefore, there is an incentive for voluntary compliance. The NTL lists the type of information that BOEMRE will review as follows:

- subsea containment and capture equipment, including containment domes and capping stacks;
- subsea utility equipment, including hydraulic power, hydrate control, and dispersant injection equipment;
- riser systems;
- remotely operated vehicles;
- capture vessels;
- support vessels; and
- storage facilities.

NTL 2010-N06 "Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS"

This NTL, effective June 18, 2010, explains the procedures for the lessee or operator to submit supplemental information for new or previously submitted EP's, DPP's, or DOCD's. The required supplemental information includes the following: (1) a description of the blowout scenario as required by 30 CFR 250.213(g) and 250.243(h); (2) a description of their assumptions and calculations used in determining the volume of the worst-case discharge required by 30 CFR 250.219(a)(2)(iv) (for EP's) or 30 CFR 250.250(a)(2)(iv) (for DPP's and DOCD's); and (3) a description of the measures proposed that would enhance the ability to prevent a blowout, to reduce the likelihood of a blowout, and to conduct effective and early intervention in the event of a blowout, including the arrangements for drilling relief wells and any other measures proposed. The early intervention methods of the third requirement could actually include the surface and subsea containment resources that BOEMRE announced in NTL

2010-N10, which states that BOEMRE will begin reviewing to ensure that the measures are adequate to promptly respond to a blowout or other loss of well control.

On December 13, 2010, BOEMRE issued a press release and a guidance document to provide a clear path forward for the safe resumption of deepwater drilling operations (USDOI, BOEMRE, 2010d). This guidance clarifies, in part, that although operators are not required to amend their OSRP's to include additional subsea containment information, they may do so voluntarily. The guidance further indicates that BOEMRE will review for the following specific information relating to subsea containment, in addition to that listed in NTL 2010-N10:

- source abatement through direct intervention;
- relief wells;
- debris removal; and
- if a capping stack is the single containment option offered, the operator must provide the reasons that the well design is sufficient to allow shut-in without broach to the seafloor.

An operator can comply with this guidance by submitting a Containment Plan as part of their OSRP. In evaluating the sufficiency of subsea containment information submitted by an operator, BOEMRE will examine the Mudline Shut-in Pressure for the proposed well. The BOEMRE will also evaluate factors such as debris removal from the site.

3.2.1.5.2. Offshore Response and Cleanup Technology

In the event of a spill, particularly a loss of well control, there is no single method of containment and removal that would be 100 percent effective. Spill cleanup is a complex and evolving technology. There are many situations and environmental conditions that necessitate different approaches. New technologies constantly evolve, but they provide only incremental benefits. Each new tool then becomes part of the spill-response tool kit. Each spill-response technique/tool has its specific uses and benefits (Fingas, 1995). Removal and containment efforts to respond to an ongoing spill offshore would likely require multiple technologies, including source containment, mechanical cleanup, in-situ burning of the slick, and chemical dispersants (**Table 3-8**). Even with the deployment of all of these spill-response technologies, it is likely that, with the operating limitations of today's spill-response technology, not all of the oil can be contained and removed offshore.

Because no single spill-response method is 100 percent effective, it is likely that larger spills under the right conditions will require the simultaneous use of all available cleanup methods (i.e., source containment, mechanical cleanup, dispersant application, and in-situ burning). Accordingly, the response to the DWH event employed all of these options simultaneously. The cleanup technique chosen for a spill response will vary depending upon the unique aspects of each situation. The selected mix of countermeasures will depend upon the shoreline and natural resources that may be impacted; the size, location, and type of oil spilled; weather; and other variables. The overall objective of on-water recovery is to minimize the risk of impact by preventing the spread of free-floating oil. The physical and chemical properties of crude oil can greatly affect the effectiveness of containment and recovery equipment, dispersant application, and in-situ burning. It is expected that oil found in the majority of the proposed lease sale areas could range from medium weight oil to condensate. The variety of standard cleanup protocols that were used for removing DWH oil from beaches, shorelines, and offshore water are identified in **Chapter 3.2.1.5.4.**

Most oil-spill-response strategies and equipment are based upon the simple principle that oil floats. However, as evident during the DWH event, this is not always true. Sometimes it floats and sometimes it suspends within the water column or sinks to the seafloor. Oil suspended in the water column and moving with the currents is difficult to track, and therefore recover, using standard visual survey methods (Coastal Response Research Center, 2007).

The National Commission on the British Petroleum (BP) *Deepwater Horizon* Oil Spill and Offshore Drilling's staff working paper 7 (Oil Spill Commission, 2011a), entitled "Response/Clean-Up Technology

Research & Development and the BP Deepwater Horizon Oil Spill," has initially indicated that, since the *Exxon Valdez* spill occurred, both the industry and government have underfunded spill-response research and development and, as a result, cleanup technology used during the DWH event was outdated and inadequate. This draft report also makes the recommendation that the Commission consider the fact that future improvements in spill prevention and source containment should not replace the need to provide incentives and funding for spill-response research and development for slick containment and removal, in part, because an exclusive focus on prevention and subsea containment is not an in-depth defense to an oil spill and it would preclude a valuable redundancy in response capability. As a result of this report, the Commission is presently considering various measures that could serve to advance improvements in the present-day, spill-response technology (Oil Spill Commission, 2011a).

Source Containment

To address the new improved containment systems' expectations to rapidly contain a spill as a result of a loss of well control from a subsea well addressed in NTL 2010 N-10, several oil and gas industry majors initiated the development of a new, rapid response system. This system is designed to fully contain oil flow in the event of a potential future underwater blowout and to address a variety of scenarios. The system would consist of specially designed equipment constructed, tested, and available for rapid response. It is envisioned that this system could be fully operational within days to weeks after a spill event occurs. The system is designed to operate in up to 10,000-ft (3,048-m) water depth and adds containment capability of 100,000 bbl of oil/day (4.2 million gallons/day). This new $1 billion investment can be expanded and adapted for new technologies. This equipment should be available by the end of 2011 or by early 2012. The companies that originated this system are forming a nonprofit organization, the Marine Well Containment Company (MWCC), to operate and maintain the system (MWCC, 2010a). The MWCC will provide fully trained crews to operate the system, will ensure the equipment is operational and ready for rapid response, and will conduct research on new containment technologies. At present, MWCC plans to offer this equipment to member companies and to rent it to nonmember companies. Until this equipment is available, industry has worked out a deal with BP to utilize the subsea containment equipment purpose built for the DWH event response (MWCC, 2010b). It is anticipated that this equipment will be available by early 2011.

Another option for source control and containment is through the use of the equipment stockpiled by Helix Energy Solutions Group, Inc (Driver, 2010). The Helix initiative involves more than 20 smaller energy companies and supplements the MWCC response effort. Helix has stockpiled the equipment that it found useful in the DWH event response and is offering it to oil and gas producers for use. This system focuses on three vessels—the *Helix Producer I*, the *Q4000*, and the *Express* deepwater construction vessel, all of which played a role in the DWH event response and which continually work in the GOM. Together, the ships and related equipment can accommodate up to 55,000 bbl of oil/day, 70,000 bbl of liquid natural gas, and 95 MMcf of natural gas at depths up to 8,000 ft (2,438 m). In January 2011, the Helix system will provide only capping capability; however, cap and flow capability is supposed to be online by Spring 2011.

Mechanical Cleanup

Generally, mechanical containment and recovery is the primary oil-spill-response method used (33 CFR 153.305(a)). Mechanical recovery is the process of using booms and skimmers to pick up oil from the water surface. It is expected that the oil-spill-response equipment needed to respond to an offshore spill in the proposed WPA sale area could be called out from one or more of the following oil-spill equipment base locations: Corpus Christi, Aransas Pass, Houston, La Porte, Ingleside, Port Arthur, and Galveston, Texas; Lake Charles, New Iberia, Belle Chase, Cameron, Cocodrie, Morgan City, New Orleans, Sulphur, Houma, Fourchon, Fort Jackson, and Venice, Louisiana; Pascagoula, Mississippi; Theodore and Mobile, Alabama; or Pensacola, Fort Lauderdale, Panama City, and Tampa, Florida. Response times for any of this equipment would vary, dependent on the location of the equipment, the staging area, and the spill site; and on the transport requirements for the type of equipment procured. It is anticipated that equipment would be procured from the closest available oil-spill equipment bases.

In rough seas, a large spill of low viscosity oil, such as a light or medium crude oil, can be scattered over many square kilometers within just a few hours. Oil recovery systems typically have swath widths of only a few meters and move at slow speeds while recovering oil. Therefore, even if this equipment can become operational within a few hours, it would not be feasible for them to encounter more than a fraction of a widely spread slick (ITOPF, 2010b). For this reason, it is assumed that a maximum of 10-30 percent of an oil spill in an offshore environment can be mechanically removed from the water prior to the spill making landfall (U.S. Congress, Office of Technology Assessment, 1990). Some newer oil skimming equipment procured internationally displayed faster recovery speed during the response to the DWH event, and some changes were also made in the logistics of how skimmers and booms were positioned offshore during this response that increased the equipment's swath width. However, for the DWH event, it was estimated that only 3 percent of the total oil spilled was picked up by mechanical equipment offshore (Lubchenco et al., 2010).

A common difficulty when deploying booms and skimmers to recover oil is coordinating vessel activities to work the thickest areas of oil (ITOPF, 2010b). It is a rule of thumb that 90 percent of the oil is in 10 percent of the area. The 10 percent of the oil that makes up 90 percent of a slick is typically sheen. For this reason, containment and recovery operations on water require extensive logistical support to direct the response effort. Additionally, the limitations that poor weather and rough seas impose on spill-response operations offshore are seldom fully appreciated. Handling wet, oily, slippery equipment on vessels that are pitching and rolling is difficult and can raise safety considerations. Winds, wave action, and currents can drastically reduce the ability of a boom to contain and a skimmer to recover oil. It is important to select equipment for a response that is suitable for the type of oil and the prevailing weather and sea conditions for a region. Efforts should generally be made to target the heaviest oil concentrations and areas where collection and removal of the oil will reduce the likelihood of oil reaching sensitive resources and shorelines. As oil weathers and increases in viscosity, cleanup techniques and equipment should be reevaluated and modified (ITOPF, 2010b).

Practical limitations of strength, water drag, and weight mean that generally only relatively short lengths of boom (tens to a few hundred meters) can be deployed and maintained in a working configuration. Towing booms at sea (e.g., in U or J configurations, which increase a skimmers swath width) is a difficult task requiring specialized vessels and trained personnel (ITOPF, 2010b). Additional boom limitations are discussed in **Chapter 3.2.1.5.4**. Because skimmers float on the water surface, they experience many of the operational difficulties that apply to booms, particularly those posed by wind, waves, and currents (ITOPF, 2010b). The effectiveness of any skimmer depends upon a number of factors, in addition to the ambient weather and sea conditions, including the type of oil, the thickness of the oil, the presence of debris in the oil or in the water, and the location of the spill (Fingas, 1995). Even moderate wave motion can greatly reduce the effectiveness of most skimmer designs (ITOPF, 2010b). In high sea-state conditions, many skimmers, especially weir and suction skimmers, take up more water than oil (Fingas, 1995). Because of the various constraints placed upon skimmers in the field, their design capacities are rarely realized. Experience from numerous spills has consistently shown that skimmer recovery rates reported under test conditions cannot be sustained during a spill response (ITOPF, 2010b). The availability of sufficient oil-storage facilities is necessary to ensure continuous oil-spill recovery. This storage needs to be easy to handle and easy to empty once full so that it can be used repeatedly with the least interruption in recovery activity (ITOPF, 2010b).

There are no proven methods for the containment of submerged oil, and methods for recovery of submerged oils have limited effectiveness. Efforts to mechanically contain and/or recover suspended oil have focused on different types of nets, either the ad hoc use of fishing nets or specially designed trawl nets. There has been some research conducted on the design of trawl nets for the recovery of emulsified fuels. However, the overall effectiveness for large spills is expected to be very low. The suspended oil can occur as liquid droplets or semisolid masses in sizes ranging from millimeters to meters in diameter (Coastal Response Research Center, 2007).

If an oil spill occurs during a storm, spill response from shore would occur following the storm. Spill response would not be possible while storm conditions continued, given the sea-state limitations for skimming vessels and containment boom deployment. However, oil released onto the ocean surface during a storm event would be subject to accelerated rates of weathering and dissolution (i.e., oil and water would be agitated, forcing oil into smaller droplets and facilitating dissolution of the high end aromatic compounds present).

Dispersants

When dispersants are applied to spilled crude oil, the surface tension of the oil is reduced, allowing wind and wave action to break the oil into tiny droplets that are dispersed into the upper portion of the water column. Oil that is chemically dispersed at the surface will move into the top 20 ft (6 m) of the water column where it will mix with surrounding waters and begin to biodegrade (U.S. Congress, Office of Technology Assessment, 1990, p. 19). Dispersant use, in combination with natural processes, breaks up the oil into smaller components that allows them to dissipate into the water and degrade more rapidly (Nalco, 2010). Dispersion increases the likelihood that the oil will be biodegraded, both in the water column and at the surface. While there is more analysis to be done to quantify the rate of biodegradation in the GOM after the DWH event, early observations and preliminary research results seemed to indicate that the oil biodegraded quickly; however, there are still ongoing studies assessing this issue. Bacteria that break down the dispersed and weathered surface oil are abundant in the GOM in large part because of the warm water, the favorable nutrient and oxygen levels, and the fact that oil enters the GOM through natural seeps regularly (Lubchenco et al., 2010).

Dispersant use must be in accordance with the Regional Response Team's (RRT) Preapproved Dispersant Use Manual and with any conditions outlined within a RRT's site-specific, dispersant approval given after a spill event. Consequently, dispersant use would be in accordance with the restrictions for specific water depths, distances from shore, or monitoring requirements. At this time, this manual does not give preapproval for the application of dispersant use subsea. However, USEPA is presently revisiting these RRT preapprovals in light of the dispersant issues, such as subsea application, that arose during the DWH response. For a deepwater (>1,000-ft; >305-m water depth) spill ≥1,000 bbl, dispersant application may be a preferred response in the open-water environment to prevent oil from reaching a coastal area, in addition to mechanical response. However, the window of opportunity for successful dispersant application may be somewhat narrower for some deepwater locations that are dependent upon the physical and chemical properties of oil, which tend to be somewhat heavier than those found closer to shore. A significant reduction in the window of opportunity for dispersant application may render this response option ineffective.

Based on the present location of dispersant stockpiles and dispersant application equipment in the GOM, it is expected that the dispersant application aircraft initially called out for an oil-spill response to an offshore spill in the proposed lease sale area will come from Houma, Louisiana; Stennis, Mississippi; or Mesa, Arizona. The dispersants will come from locations primarily in Texas and Louisiana. Response times for this equipment would vary, depending on the spill site and on the transport time for additional supplies of dispersants to arrive at a staging location. Based on historic information, this Supplemental EIS assumes that dispersant application will be effective on 20-50 percent (S.L. Ross Environmental Research Ltd., 2000) of the treated oil.

If an oil spill occurs during a storm, the dispersant application would occur following the storm. Aerial and vessel dispersant application would not be possible while storm conditions continued. However, oil released onto the ocean surface during a storm event would be subject to accelerated rates of weathering and dissolution (i.e., oil and water would be agitated, forcing oil into smaller droplets and facilitating dissolution of the high-end aromatic compounds present).

In-situ Burning

In-situ burning is an oil-spill cleanup technique that involves the controlled burning of the oil at or near a spill site. The use of this spill-response technique can provide the potential for the removal of large amounts of oil over an extensive area in less time than other techniques. In-situ burning involves the same oil collection process used in mechanical recovery, except instead of going into a skimmer, the oil is funneled into a fire boom, which is a specialized boom that has been constructed to withstand the high temperatures from burning oil. While in-situ burning is another method for disposing of oil that has been collected in a boom, this method is typically more effective than skimmers when the oil is highly concentrated. In-situ burning was successfully used in 411 burns during the DWH spill response, successfully eliminating between 220,000 and 300,000 bbl of oil from the water surface (Allen, 2010), approximately 5 percent of the Macondo oil spilled (Lubchenco et al., 2010).

Response times for bringing a fire-resistant boom onsite would vary, depending on the location of the equipment, the staging area, and the spill site. If an oil spill occurs during a storm, in-situ burning would occur following the storm. In-situ burning would not be possible while storm conditions continued.

Natural Dispersion

Depending upon environmental conditions and spill size, the best response to a spill may be to allow the natural dispersion of a slick to occur. Natural dispersion may be a preferred option for smaller spills of lighter nonpersistent oils and condensates that form slicks that are too thin to be removed by conventional methods and that are expected to dissipate rapidly, particularly if there are no identified potential impacts to offshore resources and a potential for shoreline impact is not indicated. In addition, natural dispersion may also be a preferred option in some nearshore environments, such as a marsh habitat, when the potential damage caused by a cleanup effort could cause more damage than the spill itself.

3.2.1.5.3. Oil-Spill-Response Assumptions Used in the Analysis of a Most Likely Spill ≥1,000 bbl Incident Related to the Proposed Action

Tables 4-36 and 4-37 and Chapter 4.3.5.3 of the Multisale EIS present the estimated amounts of oil that will either be removed by the application of dispersants or mechanically recovered for the 4,600-bbl pipeline spill scenarios analyzed in the Multisale EIS. The scenarios assumed oils within a range of 30^{o} and 35^{o} API, which are typical for the Gulf of Mexico.

3.2.1.5.4. Onshore Response and Cleanup

Offshore response and cleanup is preferable to shoreline cleanup; however, if an oil slick reaches the coastline, it is expected that the specific shoreline cleanup countermeasures identified and prioritized in the appropriate Area Contingency Plans (ACP's) for various habitat types would be used. The sensitivity of the contaminated shoreline is the most important factor in the development of cleanup recommendations. Shorelines of low productivity and biomass can withstand more intrusive cleanup methods such as pressure washing. Shorelines of high productivity and biomass are very sensitive to intrusive cleanup methods and, in many cases, the cleanup is more damaging than allowing natural recovery.

Oil-spill-response planning in the U.S. is accomplished through a mandated set of interrelated plans. The ACP's cover subregional geographic areas and represent the third tier of the National Response Planning System mandated by OPA. The ACP's are a focal point of response planning, providing detailed information on response procedures, priorities, and appropriate countermeasures. The Gulf coastal area that falls within USCG District 8 is covered by the One Gulf Plan ACP, which includes separate Geographic Response Plans for areas covered by USCG Sector Corpus Christi, Sector Houston/ Galveston, Sector Port Arthur, Sector Morgan City, Sector New Orleans, and Sector Mobile. The Miami ACP covers the remaining Gulf coastal area. The ACP's are written and maintained by Area Committees assembled from Federal, State, and local governmental agencies that have pollution response authority; nongovernmental participants may attend meetings and provide input. The coastal Area Committees are chaired by respective Federal On-Scene Coordinators from the appropriate USCG Office and are comprised of members from local or area-specific jurisdictions. Response procedures identified within an ACP or its Geographic Response Plan(s) reflect the priorities and procedures agreed to by members of the Area Committees.

If an oil slick reaches the coastline, the responsible party will be required to use the specific shoreline cleanup countermeasures identified and prioritized for the various habitat types potentially impacted in the appropriate ACP's that cover these areas. However, due to the lack of specific and detailed response information in the existing Gulf of Mexico ACP's, the response to the DWH event required that separate, more detailed plans be developed for protection of these shoreline areas after much additional consultation between the Unified Command and local government agencies. The detailed plans developed during the DWH response are being incorporated into the geographic response plans as appropriate for the One Gulf Plan/ACP(s).

The single, most-frequently recommended, spill-response strategy for the areas identified for protection in all of the applicable ACP's or its Geographic Response Plans is the use of a shoreline boom to deflect oil away from coastal resources such as seagrass beds, marinas, resting areas for migratory birds, bird and turtle nesting areas, etc. Since oil spilled at sea tends to move and spread rapidly into very thin layers, boom is deployed to corral the oil on the water to enhance recovery effectiveness of skimmers and other response technologies. Boom is also used to protect shoreline areas and to minimize the consequences of an oil spill reaching shore. There are tradeoffs in deciding where and when to place boom because, once deployed, boom is time consuming to tend and to relocate. For example, booming operations are sensitive to wind, wave, and currents and need to be tethered and secured to keep them from moving. Rough seas can tear, capsize, or shred boom. Currents over 1.5 kn (1.7 mph) or even a wake from a boat can send oil over or under a boom. Untended boom can become a barricade to wildlife and to ship traffic. Boom anchors can damage some habitats. During the DWH event, it was discovered that hard boom often did more damage in the marsh it was intended to protect than anticipated after weather conditions ended up stranding the boom back into the marsh (USDOC, NOAA, 2010a).

If a shoreline is oiled, the selection of the type of shoreline remediation to be used will depend on the following: (1) the type and amount of oil on the shore; (2) the nature of the affected coastline; (3) the depth of oil penetration into the sediments; (4) the accessibility and the ability of vehicles to travel along the shoreline; (5) the possible ecological damage of the treatment to the shoreline environment; (6) weather conditions; (7) the current state of the oil; and (8) jurisdictional considerations. To determine which cleanup method is most appropriate during a spill response, decisionmakers must asses the severity and nature of the injury using Shoreline Cleanup and Assessment Team survey observations. These onsite decisionmakers must also estimate the time it will take for an area to recover in the absence of cleanup (typically considering short term to be 1-3 years, medium term to be 3-5 years, and long term greater than 5 years (National Response Team, 2010).

Shoreline Cleanup Countermeasures

The following assumptions regarding the clean up of spills that contact coastal resources in the area of consideration reflect a generalization of the site-specific guidance provided in the ACP's or its Geographic Response Plans applicable to the GOM. As stated in **Chapter 4.3.1.4**, it is expected that a typical oil spilled as a result of an accident associated with the WPA proposed action would be within the range of 30-35° API. Since the following discussion is intended to address the most likely spill scenario discussed in **Chapter 3.2.1.5.3**, cleanup countermeasures for medium-weight oil are all that are included in the following discussion. The ACP's applicable to the Gulf coastal area cover a vast geographical area. The differences in the response priorities and procedures among the various ACP's or its Geographic Response Plans reflect the differences in the identified resources needing spill protection in the area covered by each ACP or the Geographic Response Plans.

- *Barrier Island/Fine Sand Beaches Cleanup*: After the oiling of a barrier island/fine sand beach with a medium-weight oil, applicable cleanup options are manual removal, trenching (recovery wells), sediment removal, cold-water deluge flooding, shore removal/replacement, and warm-water washing. Other possible shoreline countermeasures include low-pressure cold-water washing, burning, and nutrient enhancement. Responders are requested to avoid the following countermeasures: no action; passive collection (sorbents); high-pressure, cold-water washing; hot-water washing; slurry sand blasting; vacuum; and vegetation cutting.

- *Fresh or Salt Marsh Cleanup*: In all cases, cleanup options that avoid causing additional damage to the marshes will be selected. After the oiling of a fresh or salt marsh with medium-weight oil, a preferred cleanup option would be to take no action. Another applicable alternative would be trenching (recovery wells). Shore removal/replacement, vegetation cutting, or nutrient enhancement could be used. The option of using vegetation cutting as a shoreline countermeasure will depend upon the time of the year and will be considered generally only if the re-oiling of birds is possible. Chemical treatment, burning, and bacterial addition are countermeasures under consideration. Responders are advised to avoid manual removal, passive collection, debris removal/heavy equipment, sediment removal, cold-water flooding, high- or low-pressure cold-water washing, warm-water washing, hot-water washing, slurry sand blasting, and shore removal/replacement.

- *Coarse Sand/Gravel Beaches Cleanup*: After the oiling of coarse sand/gravel beach with medium-weight oil, applicable cleanup options are manual removal, trenching (recovery wells), sediment removal, cold-water deluge flooding, and shore removal/ replacement. Other possible shoreline countermeasures include low-pressure, cold-water washing; burning; warm-water washing; and nutrient enhancement. Responders are requested to avoid the following countermeasures: no action; passive collection (sorbents); high-pressure, cold-water washing; hot-water washing; slurry sand blasting; vacuum; and vegetation cutting.
- *Exposed or Sheltered Tidal Flats Cleanup*: After the oiling of an exposed or sheltered tidal flat with medium-weight oil, the preferred cleanup option is no action. Other applicable shoreline countermeasures for this resource include trenching (recovery wells) and cold-water deluge flooding. Other possible shoreline countermeasures listed include low-pressure, cold-water washing; vacuum; vegetation cutting; and nutrient enhancement. Responders are requested to avoid manual removal; passive collection; debris removal/heavy equipment; sediment removal; high-pressure, cold-water washing; warm-water washing; hot-water washing; slurry sand blasting; and shore removal replacement.
- *Seawall/Pier Cleanup*: After the oiling of a seawall or pier with a medium-weight oil, the applicable cleanup options include manual removal; cold-water flooding; low- and high-pressure, cold-water washing; warm-water washing; hot-water washing; slurry sand blasting; vacuum; and shore removal replacement. Other possible shoreline countermeasures listed include burning and nutrient enhancement. Responders are requested to avoid no action, passive collection (sorbents), trenching, sediment removal, and vegetation cutting.

3.2.2. Losses of Well Control

The BOEMRE requires that all losses of well control be reported to BOEMRE. Effective July 17, 2006, this Agency revised the regulations for loss of well control incident reporting, which were further clarified in NTL 2010-N05, "Increased Safety Measures for Energy Development on the OCS," effective June 8, 2010. Operators are required to document any loss of well control event, even if temporary, and the cause of the event by mail or email to the addressee indicated in the NTL. The operator does not have to include kicks that were controlled but should include the release of fluids through a flow diverter (a conduit used to direct fluid flowing from a well away from the drilling rig).

The current definition for loss of well control is as follows:

- uncontrolled flow of formation or other fluids (the flow may be to an exposed formation [an underground blowout] or at the surface [a surface blowout]);
- uncontrolled flow through a diverter; and/or
- uncontrolled flow resulting from a failure of surface equipment or procedures.

Not all loss of well control events result in blowouts; defined as any of the 3 loss of well control events above, but most commonly thought of as a release to the human environment. A loss of well control can occur during any phase of development, i.e., exploratory drilling, development drilling, well completion, production, or workover operations. A loss of well control can occur when improperly balanced well pressure results in sudden, uncontrolled releases of fluids from a wellhead or wellbore (PCCI Marine and Environmental Engineering, 1999; Neal Adams Firefighters, Inc., 1991). From 2006 to 2009, of the 23 loss of well control events reported in the GOM, 6 (26%) resulted in loss of fluids at the surface or underground (USDOI, BOEMRE, 2010e). In addition to spills, the loss of well control can resuspend and disperse bottom sediments. Historically, since 1971, most OCS blowouts have resulted in the release of gas; blowouts resulting in the release of oil have been rare.

The most recent blowout occurred on April 20, 2010, at the Macondo well in Mississippi Canyon Block 252 (DWH event). Although this is statistically a rare event, the blowout resulted in the release of 4.9 million bbl of oil (Lubchenco et al., 2010) and large quantities of gas to the subsea environment. To date, a gas volume release for Macondo has not been officially calculated as a Government estimate, but BOEMRE has made an estimate of 15 Bcf of gas released by Macondo, in absence of any other attempt at quantifying the release (DeCort, official communication, 2010). A multi-agency Government estimate for the oil released by Macondo was made by Lubchenco et al. (2010) in early August 2010 and has not been revised to date.

Prior to the DWH event, two of the largest spills resulting from blowouts on the Gulf of Mexico OCS occurred in 1970, releasing 30,000 and 40,000 bbl of oil, respectively. Since 1970 there has been a total of 13 losses of well control events that have resulted in >50 bbl of oil being spilled. Most of these losses of well control were of short duration, more than one-half lasting less than a day (USDOI, BOEMRE, 2010e). In contrast, the DWH event continued uncontained for 87 days, between April 20 and July 15, 2010.

As shown by the DWH event, the loss of well control in deep water has presented obstacles and challenges that would not be encountered during a loss of well control in shallow waters. Although many of the same techniques used for wild well control efforts in shallow water were used to attempt to control the Macondo well, these well control efforts were hindered by water depth, which required reliance solely upon the use of ROV's for all well intervention efforts. This is a concern in deep water because the inability to quickly regain control of a well increases the size of a spill, as occurred during the DWH event. The DWH event required that the operator attempt well-control efforts at the seabed in very deep water depths (over 5,000 ft; 1,524 m), and after the explosions and fire that sunk the *Deepwater Horizon*, key personnel were missing who could have accessed surface switches to shut down the well if a functional BOP was installed.

As indicated by Neal Adams Firefighters, Inc. (1991) and by the DWH event, there are several options that could be attempted to control a well blowout. Common kill techniques include (1) bridging, (2) capping/shut-in, (3) capping/diverting, (4) surface stinger, (5) vertical intervention, (6) offset kill, and (7) relief wells (Neal Adams Firefighters, Inc. 1991). Although much has been learned about well control in deep water as a result of the DWH event, if a deepwater subsea blowout occurs in the future, it is likely that an operator would be required to immediately begin to drill one or more relief wells to gain control of the well. This may be required whether or not this is the first choice for well control because the relief well is typically considered the ultimate final solution for regaining well control in such circumstances.

Although it can take months, the actual amount of time required to drill the relief well depends upon the following: (1) depth of formation below mudline; (2) complexity of the intervention; (3) location of a suitable rig; (4) type of operation that must be terminated in order to release the rig (e.g., may need to complete a casing program before releasing the rig); and (5) any problems mobilizing personnel and equipment to the location.

The major differences between a blowout during the drilling phase versus the completion or workover phases is the drilling well tendency to "bridge off." Bridging is a phenomenon that occurs when severe pressure differentials are imposed at the well/reservoir interface and the formation around the wellbore collapses and seals the well. Deepwater reservoirs are susceptible to collapse under "high draw down" conditions. However, a completed well may not have the same tendency to passively bridge off as would a drilling well involving an uncased hole. Bridging would have a beneficial effect for spill control by slowing or stopping the flow of oil from the well (PCCI Marine and Environmental Engineering, 1999). There is a difference of opinion among blowout specialists regarding the likelihood of deepwater wells bridging naturally in a short period of time. Completed wells, or those in production, present more severe consequences in the event of a blowout due to the hole being fully cased down to the producing formation, which lowers the probability of bridging (PCCI Marine and Environmental Engineering, 1999). Therefore, the potential for a well to bridge is greatly influenced by the phase of a well. See **Chapter 3.2.1.5** for a discussion of planned well-source containment options that were designed to address an ongoing loss of well control event.

In 2007, this Agency (Izon et al., 2007) looked at the occurrences of blowouts during a 15-year period. From 1992 to 2006, 39 blowouts occurred at a rate of one blowout for every 387 wells drilled.

These numbers are down from the previous 15-year period where 87 blowouts occurred at a rate of one blowout for every 246 wells drilled. The majority of blowouts (84%) occurred at water depths <500 ft (152 m), which corresponds to where most of the wells in the GOM have been drilled. Forty-one percent of the blowouts lasted 1-7 days, and cementing problems were associated with 18 of the 39 blowouts. Flow diverters were used in 20 of the 39 blowouts with success reported in 16 out of 20. The occurrence of loss of well control events has improved over the last 25 years, and most loss of well control events are recoverable onsite and result in no environmental releases. Industry challenges remain as operators move into ultra-deepwater areas and seek deeper geologic prospects with little knowledge of the subsurface environment and with the use of new technologies in both familiar and unfamiliar environments.

Blowout Preventers

A BOP is a device with a complex of choke lines and hydraulic rams mounted atop a wellhead designed to close the wellbore with a sharp horizontal motion that may cut through or pinch shut casing and sever tool strings. Depending on how it is configured, a BOP could weigh 250 tons and cost from $25 to $35 million, and higher. The BOP's were invented in the early 1920's and have been instrumental in ending dangerous, costly, and environmentally damaging oil gushers on land and in water. The BOP's have been required for OCS oil and gas operations from the time offshore drilling began in the late 1940's.

The BOP's are actuated as a last resort upon imminent threat to the integrity of the well or the surface rig. For cased wells, the normal situation, the hydraulic ram may be closed if oil or gas from an underground zone enters the wellbore to destabilize it. By closing a BOP, usually by redundant surface-operated and hydraulic actuators, the drilling crew can prevent explosive pressure release and allow control of the well to be regained by balancing the pressure exerted by a column of drilling mud with formation fluids or gases from below.

Surface BOP's typically differ from subsea BOP's by the reduced redundancy in the stack. This is in part due to the ease of maintenance and repair to the stack at the surface in comparison to the subsea BOP, which may have to be retrieved for these issues. As there are typically fewer components, the surface BOP stacks are lighter as a result. The differences in typical configuration between surface BOP's and subsea BOP's are shown below, from the top to the bottom of typical BOP stacks.

Subsea BOP	Surface BOP
Upper Annular Preventer	Annular Preventer
Lower annular Preventer	NE
Blind Shear Ram	NE
Upper Pipe Ram	Upper Pipe Ram
Choke Valves	Middle Pipe Ram
Middle Pipe Ram	Choke Valves
Lower Pipe Ram	Lower Pipe Ram
Subsea Isolation Device	NE

NE = no equivalent
Source: MCS Advanced Subsea Engineering (2010, Table 3.2).

Both annular and shear rams are typically configured together in the subsea BOP stack to create redundancy. Because BOP's are important for the safety of the drilling crew, as well as the rig and the wellbore itself, BOP's are regularly inspected, tested, and refurbished. The post-DWH event regulations and inspection program required for BOP's is discussed below and in **Chapter 1.3.1**. Among the changes are new provisions for BOP testing.

The most important components of the BOP for regaining control of a wild well are rams. There are four types of rams: pipe ram; annular preventer; shear ram; and blind shear ram (MCS Advanced Subsea Engineering, 2010, pp. 17-20).

Pipe Ram

A pipe ram is an element that acts as a seal in the BOP. There are rams for high-pressure and low-pressure applications. Pipe rams were historically comprised of two half circles that were designed to seal around the drill pipe; however, there are newer styles of rams that are variable and that fit a range of pipe sizes.

Annular Preventer

The annular preventer is a component of the pressure control system in the BOP that is usually situated at the top of the stack. It is a device that can form a seal in the annular space around any object in the wellbore or upon itself, enabling well control operations to commence. A reinforced elastomer packing element is compressed by hydraulic pressure to affect the seal.

Blind Ram and Blind Shear Ram

A blind ram is used to seal an open hole when there are no tools or drill string in the bore. Blind shear rams have a cutting edge that is designed to shear drill string, casing, or production tubing that may be in the hole, allowing the blind rams to seal the hole. Blind rams are intended to seal against each other to effectively close the hole; they are not intended to seal against any drill pipe or casing.

Subsea Isolation Device

A subsea isolation device allows a well to be sealed below the BOP stack to allow the rig or drillship to move off location in case of an emergency disconnect situation, such as an approaching hurricane. Where there is the need to disconnect from the wellhead in a blowout or other well control situation, a subsea isolation device may be used. The subsea isolation device is placed at the mudline with riser and wellhead connectors set up to allow emergency disconnect if needed. The subsea isolation devices have different names depending on the operator and manufacturer. They can be called a subsea isolation device, environmental safety guard, surface disconnect system, or subsea shut-off device, just to name a few. The subsea isolation device is not designed for typical well control and is not considered a BOP. It is designed to seal the well and disconnect the riser from the seafloor if required, allowing safe well abandonment and the possibility to enter the well at a later point. The subsea isolation devices are typically activated with an acoustic trigger or from an ROV control panel.

Choke Valves

Choke valves are the means of controlling the BOP or subsea isolation device functions. They can either be fixed or adjustable. An adjustable valve has the advantage of allowing more control over fluid control parameters; however, under prolonged use, they may be more susceptible to erosion than fixed valves.

This Agency's role during the efforts to actuate the BOP after the sinking of the DWH event was evaluated in staff working paper 6 for the National Commission on the BP *Deepwater Horizon* Oil Spill and Offshore Drilling (Oil Spill Commission, 2011b, pp. 4-7). The staff's evaluation described limited supervision by this Agency in the early spill containment effort, but it was in line with [this Agency's] established role in overseeing deepwater drilling in general. The Commission staff attributed this Agency's role to stem from a lack of resources and absence of important operational expertise (Oil Spill Commission, 2011b, pp. 7-8).

Blowout Preventer Effectiveness

The Technology Assessment & Research (TA&R) Program is a research element within BOEMRE's Regulatory Program. The TA&R Program supports research associated with operational safety and pollution prevention, as well as oil-spill response and cleanup capabilities. The TA&R Program was established in the 1970's to ensure that industry operations on the OCS incorporated the use of the best available and safest technologies, subsequently required through the 1978 OCSLA amendments and

Energy Policy Act of 2005 (EPAct). The TA&R Program is comprised of three functional research activities: operational safety and engineering research; oil-spill-response research; and renewable energy research. There is no automatic connection between TA&R research outputs and changes to BOEMRE requirements. Management discretion is involved between the research outputs produced by TA&R and how or if they lead to a change in regulation.

The studies carried out by this Agency on the effectiveness of BOP's over the last 12 years have resulted in a mixed assessment of their effectiveness. An unavoidable condition involved in any BOP study to sample unit effectiveness is that a test is destructive for the casing or drill string components elected as representative and is also unique to the conditions under which the test was deployed. Tests should be as realistic as possible of in situ conditions and materials used. As a review of the TA&R studies that have been undertaken shows (below), this is not often the case. This Agency has never required destructive testing; such a program has not been proposed in recent BOEMRE, post-DWH regulations (**Chapter 1.3.1**). Routine destructive testing of equipment like a BOP may diminish its lifespan making such a test program costly.

Another train of assumption that underpins effectiveness testing would be (1) that other BOP units from a manufacturer are assumed to be representative of the same type and design, (2) that units are maintained according to specification, and (3) that all modifications or maintenance for BOP units available for deployment have been carried out under a system of design control and configuration management so that rig crews know that a properly maintained or modified unit is deployed, and so that if a crew has occasion to actuate a BOP in an emergency, they have access to accurate drawings for any modification that may have been made to it. For example, there were apparently modifications made to the Macondo BOP in a maintenance overhaul. The spill response engineers seeking to activate the BOP with ROV's did not understand what modifications had been made and did not have accurate drawings of its modified configuration (Webb, 2010).

Tetrahedron, Inc. (1996) conducted a study using data provided by the oil industry to determine BOP failure rates when tested at 7- and 14-day time intervals. The regulation 30 CFR 250.57 at that time required that a BOP must be tested when

- installed;
- before drilling each string of casing or before continuous operations in cases where the cement is not drilled out; and
- at least once a week, but not exceeding 7 days between pressure tests, alternating between control stations. A period of more than 7 days between BOP tests is allowed when there is a stuck pipe or there are pressure control operations and remedial efforts are being performed, provided that the pressure tests are conducted as soon as possible and before normal operation resumes.

When a unit is deployed on a well site and installed, BOEMRE requires a pressure-up and hold time test for the ram components without actually actuating the rams in the field. Tests succeed or fail on the ability for the system to hold specified pressures at intervals from 3 to 5 minutes. Tetrahedron, Inc. (1996) used the data to look at BOP component failures as well as failure rates between surface BOP's and subsea BOP's. For this study, a test of BOP failure was reported when any piece of equipment had to be physically repaired or sent to the shop for repairs for both initial and subsequent tests. Data was collected from 155 BOP (surface and subsea) tests, from which 63 were reported as failures (41%). When looking at surface versus subsea BOP's, 22 out of 50 surface tests failed (44%) and 12 out of 56 subsea tests failed (21%).

As a result of this study, this Agency proposed a rule change to lengthen the pressure testing interval to not exceed 14 days (*Federal Register*, 1997b) and expanded on how testing was to be carried out for BOP's in general. This Agency concluded that no statistical difference existed in failure rates for BOP's tested between 0- to 7-day intervals and 8- to 14-day intervals (*Federal Register*, 1998, p. 29604). That is to say, the testing interval was not a controlling factor. This Agency, in effect, accepted that whether tested every 7 days or every 14 days, equivalent marginal test results were obtained. The rule was finalized (*Federal Register*, 1998), amending 30 CFR 250.406, 250.407, and 250.516 in line with the proposed changes to expand required BOP testing to the longer interval.

Holand (1999) conducted a study on the reliability of subsea BOP's for deepwater applications reported for 83 wells drilled in the years 1997 and 1998. He looked at the number of days the BOP's were in service and the number of hours lost due to reported BOP failures. The failures were also classified as safety noncritical and safety critical. Safety noncritical failures are failures that occur on the rig during operation and testing of the BOP, whereas safety critical failures occur after testing and during a period in which the BOP is acting as a barrier. There were 117 BOP safety critical failures reported during 4,009 BOP service days, with a total of 3,637.5 hours lost. The failure rate for safety critical systems, the point at which the BOP was preventing a gas or fluid release, was 57 percent. The main cause of BOP failures were the ram preventers and the main control systems.

Holand and Skalle (2001) conducted a study looking at BOP performance and deepwater kicks. This study ties back to the Holand (1999) study that reported 117 BOP failures for 83 wells drilled in the years 1997 and 1998. There were 48 pressure kicks reported during the drilling of the 83 wells. There are various techniques used to suppress and equalize pressure kicks (kick-killing operations), and Holand and Skalle concluded that kick killing operations were a likely contributor to four of the BOP failures.

West Engineering Services (2002) conducted a study on the shearing capability of the BOP shear ram based on results of fully actuated BOP's from operator-provided effectiveness tests. Data was provided from seven rigs that conducted tests without hydrostatic pressure and from six rigs that tested with hydrostatic pressure. This study looked at both operational and nonoperational conditions. Five of seven tests passed (71%) the test without the hydrostatic pressure, but only three of six passed (50%) the test that accounted for increased hydrostatic pressure. The study acknowledged that different grades of casing were not tested.

When shear tests are conducted, operational parameters, such as the increased hydrostatic pressure at deepwater depths or the complete range of casing steel or pipe thicknesses, are rarely factored in. If a BOP is actuated at a casing joint, the casing is greatly overthickened at that point. Barstow et al. (2010) reported that pipe joints can make up almost 10 percent of the drill pipe's length. Should the shear ram be opposite the threading or upset (the thickening of the pipe to compensate for the threads that may be externally or internally expressed on the pipe wall) of a pipe joint, the ram would be trying to shear a pipe overthickened perhaps beyond its design specifications. However, if two rams are part of the BOP configuration, at least one ram is likely to be opposite pipe without a joint at all times. The BOP's account for such a condition by using both pipe and annular rams at different levels in the BOP stack; the assumption being that redundant system would be failsafe. Double ram configurations, however, were not required by this Agency, nor are they required by current post-DWH event BOEMRE regulations (**Chapter 1.3.1**).

West Engineering Services (2004) conducted a study to evaluate if a rig's BOP equipment could shear pipe to be used in a given drilling program at the most demanding condition to be expected. The study was prompted by the advances in drilling pipe metallurgy combined with larger and heavier pipe sizes used in deepwater drilling programs. West Engineering Services' (2004, p. 3-1) evaluation followed their 2002 study that referred to the 2002 results as "a grim snapshot" of industry's preparedness. West reported that the latest generation of high-ductility drilling pipe has been seen in some cases to double the shearing pressures required to sever the pipe compared with lower ductility pipe of the same weight, diameter, and grade through which only careful record keeping aboard the rig can determine which pipe is of what specification. West Engineering Services (2004) concluded that pressures that should be considered when predicting successful pipe shear often are not, such as net hydrostatic pressure at water depth (combined pressure effects of seawater, BOP hydraulic fluid, and drilling mud) and closing rams against the pressure in a wellbore kick. The following are among West Engineering Services' recommendations: (1) design BOP stack for drilling programs using the worst-case information, such as maximum anticipated drilling pipe specifications, and compensatory pressures at depth acting to require a higher shear strength to separate pipe; (2) establish a maximum length for tool joints and upsets; (3) stop designating drill pipe weight per foot in favor of actual pipe wall thickness; (4) establish an industry-wide database of shear forces/pressures in materials tests carried out by prescribed procedure with prescribed test parameters and material test specifications; and (5) encouraging industry to share data, a role for this Agency. Part of the post-DWH event, spill regulatory changes for 30 CFR 250.416(e) is that third-party verification is required for all BOP's that the blind-shear rams installed in the BOP stack are capable of shearing the drill pipe in the hole under maximum anticipated surface pressure.

West Engineering Services (2006) conducted a study to assess the acceptability and safety of using equipment, particularly BOP's and wellhead components, at pressures in excess of rated working pressure. Running equipment in excess of the maximum operating pressure is considered a poor practice and is rarely seen except for accidental or emergency use.

Melendez et al. (2006) wrote his Master's Thesis at Texas A&M on the risk assessment of surface versus subsea BOP's on MODU's. Melendez et al. determined that the reliability of the surface BOP system compared with the subsea BOP system was nearly equal. This was the case even as the subsea BOP system used more redundant components than the surface BOP system. Melendez et al. (2006) also determined that the addition of a subsea isolation device improved the system reliability and recommended subsea isolation devices be used for deepwater operations in the GOM.

MCS Advanced Subsea Engineering (2010) conducted a risk analysis on the use of surface BOP's. MCS Advanced Subsea Engineering concluded that a surface BOP carries more potential risk to the vessel and personnel, but it may not increase the overall risk of the operation. Although the BOP is closer to the vessel and allows easy access by rig personnel, the crew exposure time during a wild well condition is lessened because of a simpler and cleaner kill operation at the surface. Proper inspections and maintenance is critical because the BOP is the only barrier between the vessel and personnel during a catastrophic blowout condition.

Conclusions

Izon et al. (2007) indicate that approximately 10 percent of all wells drilled experienced some loss of well control incidents over the years 1992-2006, an improvement from 35 percent in the previous 15-year period. Most loss of well control events are recoverable and result in no environmental releases.

Despite a mixed assessment of BOP effectiveness over the last 12 years, this Agency has made no changes in regulation for BOP's in the face of such ambiguous results. The need for redundant well control systems was recognized and judged desirable in TA&R studies. The TA&R studies conclude that the failure rate for surface BOP's was worse than for subsea BOP's (Tetrahedron, Inc., 1996) but that both types of units approached 50 percent failure rates in effectiveness studies. No TA&R study was carried out under strictly controlled conditions that simultaneously accounted for different BOP ram types, rig mount locations, the metallurgy and thickness of casing steel, or deepwater pressure and temperature conditions.

The new post-DWH event safety requirements put in place on October 14, 2010 (*Federal Register*, 2010b), included several added regulations to improve the safety of well control systems (**Chapter 1.3.1**). These regulations include the following: (1) seafloor function testing of ROV intervention and deadman systems—30 CFR 250.516(d), 30 CFR 250.616(h), and 30 CFR 250.449(j) and (k); (2) third-party certification that the shear rams will shear drill pipe under maximum anticipated pressure—30 CFR 250.416(e); (3) registered professional engineer certification that the well design is appropriate for expected wellbore conditions—30 CFR 250.420(a); (4) use of dual mechanical barriers for the final casing string—30 CFR 250.420(b); (5) negative pressure testing of individual casing strings—30 CFR 250.423(c); and (5) retrieval and testing of BOP after a shear ram has been activated in a well control situation—30 CFR 250.451(i).

The BOEMRE released NTL 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources," effective November 8, 2010, to address the use of BOP's and well containment resources in the aftermath of the DWH event. The NTL only applies to operators using BOP's subsea or at the surface on floating facilities. It explains that lessees and operators submit a statement signed by an authorized company official with each application for a well permit, indicating that they will conduct all of their authorized activities in compliance with all applicable regulations, including the Increased Safety Measures Regulations (*Federal Register*, 2010a). The NTL also informs lessees that BOEMRE will be evaluating whether or not each operator has submitted adequate information demonstrating that it has access to and can deploy surface and subsea containment resources that would be adequate to promptly respond to a blowout or other loss of well control. The NTL does not require that operators submit revised OSRP's that include this containment information at this time, the operator was notified of BOEMRE's intention to evaluate the adequacy of each operator's capability to comply in the operator's current OSRP;

therefore, there is an incentive for voluntary compliance. The type of information that BOEMRE will review pursuant to this NTL includes, but is not limited to,

- subsea containment and capture equipment, including containment domes and capping stacks;
- subsea utility equipment, including hydraulic power, hydrate control, and dispersant injection equipment;
- riser systems;
- remotely operated vehicles;
- capture vessels;
- support vessels; and
- storage facilities.

3.2.3. Pipeline Failures

Significant sources of damages to OCS pipeline infrastructure are mass sediment movements and mudslides that can exhume or push the pipelines into another location, impacts from anchor drops or boat collisions, and accidental excavation or breaching because the exact whereabouts of a pipeline are uncertain.

The uncertain location of pipelines is an ongoing safety and environmental hazard. On October 23, 1996, in Tiger Pass, a channel through the Mississippi River Delta into the Gulf of Mexico near Venice, Louisiana, the crew of the Bean Horizon Corporation dredge *Dave Blackburn* dropped a stern spud (a large steel shaft that is dropped into the river bottom to serve as an anchor and a pivot during dredging operations) into the bottom of the channel in preparation for continued dredging operations. The spud struck and ruptured a 12-in diameter, submerged natural gas steel pipeline owned by Tennessee Gas Pipeline Company. The pressurized natural gas (about 930 psig) released from the pipeline enveloped the stern of the dredge and an accompanying tug, the *G.C. Linsmier*. Within seconds of reaching the surface, the natural gas ignited. The resulting fire destroyed the dredge and the tug. Twenty-eight crew members from the dredge vessel and tug boat abandoned ship or boarded nearby vessels (USDOT, National Transportation Safety Board, 1998). A description of the incident in a National Transportation and Safety Board safety recommendation (USDOT, National Transportation Safety Board, 1998) indicates that lack of awareness of the precise location of the pipeline was a major contributing factor to this accident.

On December 5, 2003, this Agency received an incident report that a cutterhead dredge barge ruptured a 20-in diameter condensate pipeline in Eugene Island Block 39. Dredging operations by COE were taking place in Atchafalaya Channel. No injuries were reported, but a small condensate spill and subsequent fire damaged the dredge barge. The incident was apparently caused by inaccurate knowledge of the pipeline's location. The global positioning system beacon was located on the barge tug rather than on the bow of the dredge barge where the suction cutterhead operated. Therefore, the true position of the pipeline relative to the suction cutterhead was in error by at least the length of the dredge barge (about 400 ft; 121 m). Lack of awareness of the precise location of the pipeline was the major contributing factor to this accident as well.

Following the 2004, 2005, and 2008 hurricane seasons, this Agency commissioned studies to examine the failure mechanisms of offshore pipelines (Atkins et al., 2007; Energo Engineering 2010; Atkins et al., 2006). **Table 3-9** shows pipelines damaged after the 2004-2008 hurricanes passing through the CPA and WPA. Much of the reported damage is riser or platform-associated damage, which typically occurs when a platform is toppled or otherwise damaged.

Table 3-10 shows the hurricane-associated spills from pipelines >50 bbl. The largest spills are typically due to pipeline movements, mudslides, anchor drops, and collisions of one type or another. Most pipeline damage occurs in shallow (<200 ft; 61 m) water because of the potential for increasing impacts of the storm on the seabed in shallow water, the relative density of pipelines, or the age and design standards of the pipeline or the platforms to which the pipelines are connected.

The future impact of hurricanes on damage to pipelines is uncertain. As oil production shifts from shallow to deeper water, there may be a consolidation of pipeline utilization that increases the risk of a large spill, but might allow a focus on the safety of a smaller number of critical pipelines.

An OCS-related spill ≥1,000 bbl would likely be from a pipeline accident where a spill size of 4,200 bbl is assumed, and it would occur less than once per year; about once every 6 years.

3.2.4. Vessel Collisions

Chapter 4.3.3 of the Multisale EIS and Chapter 3.2.2 of the 2009-2012 Supplemental EIS describes the impacting factors arising from vessel collisions in the GOM resulting from a proposed action. The discussion in this Supplemental EIS tiers from the discussion in the Multisale EIS and the 2009-2012 Supplemental EIS.

This Agency revised operator incident reporting requirements in a final rule effective July 17, 2006 (*Federal Register*, 2006b). The new incident reporting rule more clearly defines what incidents must be reported, broadens the scope to include incidents that have the potential to be serious, and requires the reporting of standard information for both oral and written reports. As part of the incident reporting rule, this Agency's regulations at 30 CFR 250.188(a)(6) requires an operator to report all collisions that result in property or equipment damage greater than $25,000. "Collision" is defined as

- the act of a moving vessel (including an aircraft) striking another vessel, or striking a stationary vessel or object (e.g., a boat striking a drilling rig or platform); and
- all collisions that result in property or equipment damage greater than $25,000 must be reported.

This Agency's data show that, from 1996 to 2009, there were 226 OCS-related collisions. Most collision mishaps are the result of service vessels colliding with platforms or vessel collisions with pipeline risers. Approximately 10 percent of vessel collisions with platforms in the OCS caused diesel spills. Fires resulted from hydrocarbon releases in several of the collision incidents. To date, the largest diesel spill associated with a collision occurred in 1979 when an anchor-handling boat collided with a drilling platform in the Main Pass leasing area, spilling 1,500 bbl. Diesel fuel is the product most frequently spilled while oil, natural gas, corrosion inhibitor, hydraulic fluid, and lube oil have also been released as the result of a vessel collision. Human error accounts for approximately half of all reported vessel collisions from 2006 to 2009.

Safety fairways, traffic separation schemes, and anchorages are the most effective means of preventing vessel collisions with OCS structures. In addition, OCS-related vessels could collide with marine mammals, turtles, and other marine animals during transit. To limit or prevent such collisions, NOAA Fisheries provides all boat operators with "Whale-watching Guidelines," which is derived from the Marine Mammal Protection Act. These guidelines suggest safe navigational practices based on speed and distance limitations when encountering marine mammals. The frequency of vessel collisions with marine mammals, turtles, or other marine animals may vary as a function of spatial and temporal distribution patterns of the living resources, the pathways of maritime traffic (coastal traffic is more predictable than offshore traffic), and as a function of vessel speed, the number of vessel trips, and the navigational visibility.

3.2.5. Chemical and Drilling-Fluid Spills

Chapter 4.3.4 of the Multisale EIS and Chapter 3.2.4 of the 2009-2012 Supplemental EIS describe the impacting factors arising from chemical and drilling fluid spills in the GOM resulting from a proposed action. The discussion in this Supplemental EIS tiers from the discussion in the Multisale EIS and the 2009-2012 Supplemental EIS.

The USCG's spill size categories for coastal and offshore waters and are based solely on spill volume.

Minor	Medium	Major
<238 bbl (<10,000 gal)	238-2,380 bbl (10,00-99,999 gal)	≥2,381 bbl (100,000 gal)

1 bbl = 42 U.S. gallons.

Chemical Spills

Chemicals are stored and used to condition drill muds and during production and in well completions, stimulation, and workover procedures. The relative quantity of their use is reflected in the largest volumes spilled. Completion fluids are the largest quantity used and are largest releases. Between 5 and 15 chemical spills are anticipated each year, with the majority being <50 bbl in size. The most common chemicals spilled are methanol, ethylene glycol, and zinc bromide. Additional production chemicals are needed in deepwater operations where gas hydrates tend to form. Spill volumes are anticipated to remain about the same, but spill frequency can be expected to improve because of advances in subsea processing.

Spills of chemicals were within the range considered normal in 2006 and 2007. Hurricanes Gustav and Ike in 2008 caused an increase in the number of chemical spills. In 2008, there were 32 chemical spills; 22 of those spills occurred because of Hurricane Ike on September 13, 2008. The largest spill was a 713-bbl spill of calcium chloride brine (USDOI, BOEMRE, 2010f).

Synthetic-based Fluid Spills

Synthetic-based fluids (SBF's) have been used since the mid 1990's. In deepwater drilling, synthetic-based muds (SBM's) can be preferred over petroleum oil-based muds (OBM's) because of the SBM's superior performance properties. The synthetic oils used in SBM's are relatively nontoxic to the marine environment and have the potential to biodegrade. Three SBF spills of ≥1,000 bbl occurred between 2001 and 2004. Between 5 and 20 SBF releases are anticipated each year, with the majority being <50 bbl in size. The volume of the synthetic portion of the drill fluid rather than the total volume of the drill fluid is now used to describe spill size. Accidental riser disconnects could result in the release of large quantities of drilling fluids. The study report, *Environmental Impacts of Synthetic-Based Drilling Fluids* (Neff et al., 2000), described in the 2009-2012 Supplemental EIS, was initiated, but it suffered a major equipment malfunction. Because the frequency of these spills has been decreasing, additional funding was not applied to continue this study.

In 2007, a SBF spill of 1,061 bbl occurred in Green Canyon Block 726. A crack in a joint on the riser was the cause of the spill (USDOI, BOEMRE, 2010f). In 2008, an SBF spill of 1,718 bbl occurred in Mississippi Canyon Block 941 because of a valve not closing properly (USDOI, BOEMRE, 2010g).

3.3. CUMULATIVE ACTIVITIES SCENARIO

The cumulative impact of a proposed action under 40 CFR 1508.7 is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or persons undertake such acts." A cumulative impacts analysis considers the resources and impact-producing factors that are part of the proposed action and OCS Program; however, it also requires (1) identification of other activities affecting the resources, ecosystems, and human environment other than the proposed actions, (2) establishment of the geographic scope for the analysis, and (3) establishment of the timeframe for the analysis.

The activities, or factors, producing impacts that are part of the WPA proposed action and that are also part of the cumulative activities scenario are described in **Chapters 3.1 and 3.2**.

Some affected resources susceptible to impacts from the proposed action described in **Chapters 4.1** also represent activities that are part of this cumulative scenario. Some of these resources are commercial fishing, recreational fishing, recreational resources, and human resources and land use.

Activities that are part of the cumulative activities scenario, but that are not part of the proposed action, include both human-induced and natural phenomena. Some of these activities are as follows:

- State Oil and Gas Activity
  - Texas
  - Louisiana
  - State pipeline infrastructure
- Other Major Factors Influencing Offshore Environments
  - dredge material disposal
  - OCS sand borrowing
  - marine transportation
  - military activities
  - artificial reefs and rigs-to-reefs development
  - offshore liquefied natural gas projects and deepwater ports
  - development of gas hydrates
  - renewable energy and alternative use
- Other Major Factors Influencing Coastal Environments
  - sea-level rise and subsidence
  - formation extraction and subsidence
  - Mississippi River hydromodification
  - maintenance dredging and navigation channels
  - coastal restoration programs
  - Coastal Impact Assistance Program
  - Gulf Coast Ecosystem Restoration Task Force
- Natural Events or Processes
  - hurricanes
  - currents as transport agents

The timeframe for the analysis first requires definition of a point from which measurements begin (baseline) and a point to which the future effects will be analyzed. The baseline for impact-producing factors for this cumulative analysis is 2010 and the 40 years leading up to it, and the future limit is the next 40 years. The 40-year time period is selected because it is the approximate longest life span of activities conducted on an individual lease. Therefore, the next 40 years is the period of time during which the activities and impacting factors that follow as a consequence of proposed WPA Lease Sale 218 would be influencing the environment. This analysis of cumulative effects is activity based; i.e., it focuses on the aggregate effects of the past, present, and reasonably foreseeable future activities that have taken or will take place within the geographic area of the WPA without itemizing the historical details of each individual past action.

The geographic scope for the analysis ultimately lies within the area where impacts can be identified, but as a general concept are defined as the WPA out to the EEZ and landward to the border of each State's coastal zone, but will vary depending on the resource. The proposed action takes place within an area of the Gulf of Mexico where current competition for OCS space is moderately intense. Competition for OCS space in the WPA is not expected to become any more intense during the next 40 years of the cumulative activities scenario, and possibly it may become slightly less intense as oil and gas production ramps down as a result of reservoir depletion.

Space-Use Conflict Intensity

Of the activities included in the cumulative activities scenario, most of them involve temporary and exclusive use of relatively small areas of the OCS over their lifetimes. Lifetimes for these activities can be days or decades, but few of them permanently or temporarily compete directly for large areas of OCS on a semi-continuous basis. Exceptions include (1) commercial fishing, (2) military uses, and (3) marine transportation activities. All of these activities spatially coexist with OCS Program activities but differ in their potential for space-use conflict by their degree of permanence or frequency.

Commercial fishing is a semi-permanent, space-use conflict for the OCS. Essentially, commercial fishing can potentially occur anywhere OCS infrastructure does not present an obstruction. Virtually all commercial trawl fishing in the GOM is performed in water depths less than 200 m (656 ft). Ninety-two percent of the 830-922 production structures projected to be installed in the WPA between the years 2007-2046 are project to be in water ≤200 m (656 ft) (Table 4-5 of the Multisale EIS). Assuming all structures are major production structures that each displace approximately 6 ha (15 ac) of OCS space without safety zones, between 4,980 and 5,532 ha (12,306 and 13,670 ac) of OCS area would be displaced over 40 years (page 4-359 of the Multisale EIS); less than 1 percent of OCS area would be converted to temporary, but dedicated, OCS use and would not be available to trawl fishing.

Military activities are temporary space-use conflicts for the OCS. The WPA includes all or parts of the following military warning areas: W-59, W-147, W-228, and W-602. The proposed Military Areas Stipulation would reduce potential impacts, particularly in regards to safety, but military and OCS activities essentially coexist except under prearranged circumstances. The reduction in potential impacts resulting from this stipulation makes multiple-use conflicts most unlikely, but without it some potential conflict with respect to safety issues is likely. The best indicator of the overall effectiveness of the stipulation may be that there has never been an accident involving a conflict between military operations and oil and gas activities in the GOM.

Marine transportation is a transitory but persistent space-use conflict over the OCS. Commercial vessels can range across the entire GOM, but higher traffic areas are generally self-restricted to transit corridors. The Gulf Intracoastal Waterway is a designated transit corridor with speed controls where it crosses open navigable GOM waters. The USCG has not yet determined a navigational safety zone during offloading operations for FPSO facilities. Other deepwater facilities may require up to a 500-m (1,640-ft) radius safety zone or 78 ha (193 ac) of space (USCG regulations, 33 CFR Chapter 1, Part 147.15). Otherwise the USCG or BOEMRE have no officially designated safety zones requiring activity set-backs from OCS facilities, although 500 m (1,640 ft) is a generally recognized safety buffer set-back from floating structures.

3.3.1. OCS Program

Chapter 4.1 of the Multisale EIS and Chapter 3.1 and 3.2 of the 2009-2012 Supplemental EIS describe the scenario from a proposed action and future OCS lease sales (OCS Program). **Chapters 3.1 and 3.2** of this Supplemental EIS describe the impacting factors and scenario for routine and accidental events, respectively, for the proposed action in this Supplemental EIS and future OCS lease sales (OCS Program).

The OCS Program scenario includes all activities that are projected to occur from past, proposed, and future lease sales during the 40-year activity period. Projected reserve/resource production for the OCS Program is from 28.562 to 32.570 BBO and from 142.366 to 162.722 Tcf of gas. Tables 4-4, 4-5, and 4-6 of the Multisale EIS present projections of the major activities and impact-producing factors related to future Gulfwide OCS Program activities. Projected new coastal infrastructure as a result of the OCS Program is shown in Table 4-9 of the Multisale EIS.

For this Supplemental EIS, the BOEMRE, Gulf of Mexico OCS Region, Resource and Evaluation Office's Modeling and Forecasting Team has reevaluated the exploration and development activity scenario for the OCS Program that was presented in the Multisale EIS and 2009-2012 Supplemental EIS. For purposes of the cumulative activities scenario for this Supplemental EIS, the judgment was made that the scenario published in the Multisale EIS and the 2009-2012 Supplemental EIS remain valid.

The level of OCS activity is connected to oil prices, resource potential, cost of development, and rig availability rather than just, or even primarily to, the amount of acreage leased. In addition to these historically recurrent factors, the effect of new regulations for OCS activity enacted after the DWH event (**Chapter 1.3.1**) have been taken into account for estimates of future activity. The impacts of activities associated with the OCS Program on biological, physical, and socioeconomic resources are analyzed in the cumulative impacts analysis sections of **Chapter 4.1**.

3.3.2. State Oil and Gas Activity

Chapter 4.1.3.1 of the Multisale EIS and Chapter 3.3.2 of the 2009-2012 Supplemental EIS discuss the activities involving State oil and gas exploration and development programs. All of the five Gulf Coast States have had some historical oil and gas exploration activity, and with the exception of Florida and Mississippi, all currently produce oil and gas in State waters. The coastal infrastructure that supports the OCS Program also supports State oil and gas activities.

State oil and gas infrastructure consists of the wells that extract hydrocarbon resources, facilities that produce and treat the raw product, pipelines that transport the product to refineries and gas plants for further processing, and additional pipelines that transport finished product to points of storage and final consumption. The type and size of infrastructure that supports production depends upon the size, type, and location of the producing field, the time of development, and the life cycle stage of operations.

Texas

The first offshore well in Texas was drilled in 1938, but the first oil discovery was not made until 1941 off of Jefferson County. The Railroad Commission of Texas is the agency charged by the Texas Legislature with the regulation of the oil and gas industry in the State of Texas. According to the Texas Railroad Commission, the peak year for crude oil production in the entire State was 1972, when 167,223 wells produced nearly 1.26 BBO (Railroad Commission of Texas, 2010). As of 2007, production had ebbed to 336 million bbl of oil. In 2008, production increased for the first time since 1991 to more than 346 million bbl of oil, before falling in 2009 (Austin-American Statesman, 2010). Between January and December 2009, production in the State's offshore areas for the 11 contiguous coastal counties of Texas yielded 229,984 bbl of oil and 85.9 MMcf of gas (**Table 3-11**).

The Lands and Minerals Division of the Texas General Land Office (TGLO) holds lease sales for oil and gas on State lands, and TGLO manages Texas State resources for the benefit of public education. The TGLO holds sales quarterly in January, April, July, and October. Because of holidays, sales are usually held on the first Tuesday of the month in January and July. Nominations for a sale are due 2 weeks after the previous sale date (e.g., nominations for the July sale would be due 2 weeks following the date of the April sale).

The TGLO developed the Energy Land and Lease Inventory System (TGLO, 2010) as an Internet mapping application that provides the public with land and lease information about State-owned submerged lands. Because Energy Land and Lease Inventory System is a tool and not the formal notification, prospective bidders should refer to the Notice for Bids and addenda to obtain the marginal number and minimum bid of the tract that they wish to bid upon for an upcoming oil and gas lease sale because the Notice for Bids and addenda are controlling. The TGLO Mineral Leasing Division uses a sealed bid process for the leasing of State lands.

The most recent oil and gas lease sale occurred on April 21, 2010. Two hundred and sixty-one (261) parcels, containing 102,426 ac (41,450 ha), of State lands were offered for oil and gas leasing by Texas State University Lands (Digital Petrodata, 2010). The number of acres offshore was unspecified.

The BOEMRE expects that Texas will conduct regular oil and gas lease sales during the 40-year cumulative activities scenario for OCS activity, although the sales' regularity could differ from current practices.

Louisiana

Louisiana has been the second most important oil- and gas-producing state after Alaska. Oil production in Louisiana began in 1902, with the first oil production in the coastal zone in 1926. The State of Louisiana issued its first offshore oil and gas lease in 1936, and in 1937 the Pure Oil Company discovered the first Louisiana oil field 1.2 mi (1.9 km) offshore of Cameron Parish using a platform built on timber pilings in water 15 ft (4.6 m) deep. Most oil is produced in southern Louisiana and most gas is produced in northern Louisiana.

The nine contiguous parishes of the coastal zone produced more than 50 percent of the State's oil during the 1950's. Oil production peaked at 513 million bbl in 1970 and gas production peaked at 7.8 MMcf in 1969 (Ko and Day, 2004a, p. 398). For the nine contiguous coastal zone parishes in 2009, the Louisiana Dept. of Natural Resources' SONRIS lite database (Louisiana Dept. of Natural Resources,

2010) showed a total of 4,266 producing wells, 43 million bbl of oil production, and 0.43 MMcf of gas production (**Table 3-12**).

Louisiana's leasing procedure is carried out by the Petroleum Lands Division of the Office of Mineral Resources and proceeds along the following procedural steps (McKeithen, 2007): (1) industry nominates acreage for leasing every month (By law, nominated tracts cannot exceed 5,000 ac [2,023 ha], but by Mineral Board policy, the size limit of a nominated tract is further limited to only 2,500 ac [1,012 ha].); (2) the nominated tracts are then advertised in official State and parish journals; (3) competitive, sealed bidding then takes place on bonus, royalty, and rental to be received by the State (The sealed bids are opened and read into the record at a public meeting of the Louisiana Mineral Board at the time and place advertised.); and (4) if it determines that the bids are sufficient, the Louisiana Mineral Board awards the leases to the highest bidder after evaluating data provided from the staff geologists from the Geology and Engineering Division of the Office of Mineral Resources. The term of the lease is limited to 3 years for inland tracts and 5 years for offshore tracts.

The most recent oil and gas lease sale occurred on April 14, 2010. Sixty-three (63) parcels containing 19,386 ac (7,845 ha) of State lands were offered for oil and gas leasing by the Office of Mineral Resources on behalf of the State Mineral Board for Louisiana (Digital Petrodata, 2010). The number of acres offshore was unspecified. The BOEMRE expects that Louisiana will conduct regular oil and gas lease sales during the 40-year cumulative activities scenario for OCS activity, although their regularity could differ from current practices.

Pipeline Infrastructure

The existing pipeline network in the Gulf Coast States is the most extensive in the world and has unused capacity (USDOI, MMS, 2007b, p. 4-63). The network carries oil and gas onshore and inland to refineries and terminals, and a network of pipelines distribute finished products such as diesel fuel or gasoline to and between refineries and processing facilities onshore (Peele et al., 2002, Figure 4.1). Expansion of this network is projected to be primarily small-diameter pipelines to increase the interconnectivity of the existing network and a few major interstate pipeline expansions. Any new larger-diameter pipelines would likely be constructed to support onshore and offshore LNG terminals. However, as discussed in **Chapter 3.3.3**, there is spare capacity in the existing pipeline infrastructure to move regasified natural gas to market, and deepwater ports can serve onshore facilities including intrastate as well as interstate pipelines.

Texas

There are 69 OCS-related pipelines that transition into Texas State lands or make landfall onshore (**Figure 3-2**). The Railroad Commission of Texas reports that there are slightly over 150,000 mi (242,402 km) of petroleum-product-carrying intrastate pipelines, but no differentiation was provided for the length of pipeline in the 11 coastal counties contiguous to the GOM (Railroad Commission of Texas, 2009, p. 79).

Johnston et al. (2009) determined that annual rates of landloss within 150 m (492 ft) to either side of OCS-related pipelines were highest in the Louisiana delta plain and intermediate in the Texas coastal plain. The higher wetland loss rates for the Louisiana delta plain (eastern part of the LCA) are explained, at least in part, by the high density of pipelines located there, the relatively large number of open pipeline canals, and high rates of subsidence, coupled with reduced riverine sediment input (Johnston et al., 2009, p. 5). Lower wetland loss rates for the Texas barrier islands can be explained, at least in part, by the use of more environmentally friendly construction methods (e.g., directional drilling and push-pulling with backfilling mitigation) in sensitive environments. Trends in habitat change within the immediate vicinity of OCS-related pipelines were minor in the Texas, but significant in Louisiana. In Louisiana, open water increased while non-fresh marsh decreased (Johnston et al., 2009, p. 6). Unlike the Mississippi delta and LCA, the Texas coastal plain is not part of one large deposition system that drains much of the North American continent. Landlosses from subsidence caused by compaction of young, muddy sediment is not as important an impacting factor on the Texas coastal plain and barrier islands.

Coastal wetland loss results from a combination of natural processes such as subsidence, sea-level rise, storms, and barrier island degradation, combined with human-induced factors such as agriculture, OCS or State oil and gas infrastructure, industrial development, and urban and suburban sprawl (U.S. Dept. of the Army, COE, 2004a; Jacob et al., 2006).

In Texas, it is estimated that 9.5 percent of estuarine wetlands have been lost between the mid-1950's through the early 1990's, with similar decreases in forested wetlands (10.9%) and freshwater wetlands (4.3%) (Moulton et al., 1997).

Louisiana

There are currently 106 OCS-related (pipelines that have at one time or another carried hydrocarbon product from the OCS) pipeline landfalls in the LCA (Table 3-38 of the Multisale EIS). Included in that figure is a subset of 47 pipeline systems under DOT jurisdiction; these systems originate in Federal waters and terminate onshore or in Louisiana State waters (Gobert, 2010) (**Figure 3-2**).

Pipelines that are constructed to serve the OCS and that are located in the LCA between now and 2046 could result in direct impacts by displacing wetlands, but new construction would likely be along existing pipeline corridors and emplaced under wetlands using amphibious vehicles and required route backfilling. Pipelines International (2010) explained the procedures recently used by builders of a 30-in-diameter onshore pipeline in near Hackberry, Louisiana, and a 24-in-diameter pipeline near Lottie, Louisiana. The following 10 steps for modern pipeline construction in wetlands used for the 30-in-diameter pipeline were explained (Pipelines International, 2010):

(1) move in equipment and personnel to establish and prepare right-of-way for continuous access;

(2) identify and mark sensitive areas;

(3) determine logistics for pipe, material, and personnel movement;

(4) backhoe equipment trenches a ditch with sufficient depth and width to accommodate pipe installation;

(5) crews perform welding, coating, and quality control functions and then install sufficient floats for buoyancy purposes;

(6) equipment then guides different sections into final position before removing floats;

(7) equipment and personnel are dispatched to remote locations to weld all sections in advance of backfilling;

(8) after substantial backfill and all welding is completed, the entire line is subjected to hydrostatic testing to confirm suitability for intended use;

(9) after hydrotest, tie-ins are completed; and

(10) final cleanup and restoration, and move out equipment and personnel construction.

WPA Proposed Action Scenario: As reported is **Chapter 3.1.1.4.1** for the WPA proposed action, 0-1 new landfalls are projected. Any pipeline built as the result of the proposed action is most likely to be a subsea tie-in located in State waters; therefore, landloss projected to result from pipeline installations is not anticipated. New pipelines that landfall now call for mitigations that result in "no net loss" of wetland, no new direct wetland losses are projected over the cumulative activities scenario from OCS-related pipeline construction.

OCS Program Scenario: Pipeline landfalls in the GOM peaked in the 1970's (**Figure 3-2**). The total length of OCS-related pipeline built would be partially based on future OCS leasing activity. For the OCS Program between the years 2007 and 2046, Table 4-5 of the Multisale EIS reported that a range of 2,340 to 9,580 km (1,454 to 5,983 mi) of pipeline are projected to be built in the WPA in water depths of ≤60 ft (18 m). Table 4-9 of the Multisale EIS projects that 6-8 pipeline landfalls will take place in Texas for the OCS Program over the years 2007-2046. This estimate does not include pipeline length in Texas State waters inshore of 9 nmi (10 mi; 16 km).

3.3.3. Other Major Factors Influencing Offshore Environments

Natural and man-caused influencing factors occur in the offshore areas of Gulf States while OCS activity takes place at the same time. Some of these factors are (1) dredged material disposal, (2) OCS sand borrowing, (3) marine transportation, (4) military activities, (5) artificial reefs and rigs-to-reefs development, (6) offshore LNG projects, (7) characterization of gas hydrates, and (8) renewable energy and alternative use.

Dredged Material Disposal

Chapter 4.1.3.2.1 of the Multisale EIS discusses offshore disposal of dredged material. Dredged material is described at 33 CFR 324 as any material excavated or dredged from navigable waters of the United States. Materials from maintenance dredging are primarily disposed of offshore on existing dredged-material disposal banks and in ocean dredged-material disposal sites (ODMDS's), which are regulated by USEPA. Additional dredged-material disposal areas for maintenance or new-project dredging are developed as needed and must be evaluated and permitted by COE and relevant State agencies prior to construction.

If funds are available, dredged materials disposed offshore are available for potential beneficial uses to restore and create habitat, beach nourishment projects, and industrial and commercial development; a use called the beneficial use of dredge materials program by COE (**Chapter 3.3.4**). Virtually all ocean dumping that occurs today is maintenance dredging of sediments from the bottom of channels and waterbodies in order to maintain adequate channel depth for navigation and berthing. There are four small ODMDS's offshore Louisiana and Mississippi along open-water stretches of the main GIWW between Louisiana and Mississippi: in Louisiana ODMDS 66 (1,593 ac; 645 ha); and in Mississippi ODMDS 65A (1,962 ac; 794 ha), 65B (815 ac; 330 ha), and 65C (176 ac; 71 ha) (U.S. Dept of the Army, COE, 2008, Table 1). Dredged materials from GIWW are sidecast at these ODMDS locations. The ODMDS's utilized by COE in the cumulative activities area include those shown in **Table 3-13**. Maps show the locations for the ODMDS's in Louisiana and Texas (USEPA and U.S. Dept. of the Army, COE, 2003, Appendix D).

The COE's Ocean Disposal Database reports the amount of dredged material disposed in ODMDS's by district (U.S. Dept. of the Army, COE, 2011a). Between 2000 and 2009, the Galveston District disposed of the following quantities of dredged materials in ODMDS's.

Galveston District
Quantities of Dredged Materials Disposed of in ODMDS, 2000-2009

Year	Amount Disposed of in ODMDS	
	yd^3	m^3
2000	9,414,000	7,197,944
2001	6,828,400	5,220,995
2002	4,874,300	3,726,890
2003	8,221,300	6,286,006
2004	4,078,900	3,118,727
2005	1,250,900	956,438
2006	9,182,200	7,020,710
2007	6,361,200	4,863,774
2008	5,664,800	4,331,306
2009	7,618,900	5,825,411
Average per year	6,349,490	4,854,820

Source: U.S. Dept. of the Army, COE, 2011a.

Current figures vary for how much of the average annual 70 million yd^3 (53,518,840 m^3) that is dredged by the New Orleans District is available for the beneficial use of dredge materials program; from 15 million yd^3 (11,468,320 m^3) (U.S. Dept. of the Army, COE, 2009a, p. 26) to 30 million yd^3 (22,936,650 m^3) (Green, 2006, p. 6), or between 21 and 43 percent of the total. The remaining 79 to

57 percent of the total material dredged yearly by COE New Orleans District is disposed of in ODMDS's or is stored in temporary staging areas located inland (e.g., the Pass a Loute Hopper Dredge Disposal Site at the head of the Mississippi River's main "birdfoot" distributary channel system).

Between 2000 and 2009, the New Orleans District disposed of the following quantities of dredged materials in ODMDS's (U.S. Dept. of the Army, COE, 2011a).

New Orleans District
Quantities of Dredged Materials Disposed of in ODMDS, 2000-2009

Year	Amount Disposed of in ODMDS	
	yd^3	m^3
2000	16,377,800	12,522,466
2001	23,272,300	17,794,001
2002	57,643,200	44,073,991
2003	22,546,200	17,238,825
2004	21,156,300	16,176,107
2005	21,403,200	16,364,887
2006	13,493,400	10,317,054
2007	17,550,700	13,419,265
2008	16,800,900	12,845,968
2009	16,295,000	12,459,157
Average per year	22,653,900	17,321,172

Source: U.S. Dept. of the Army, COE, 2011a.

Cumulative Activities Scenario: The BOEMRE anticipates that over the next 40 years the amount of dredged material disposed at ODMDS's will fluctuate generally within the trends established by the Galveston and New Orleans Districts. The Galveston District has averaged about 6 million yd^3 of material dredged per year and the New Orleans District has averaged about 22 million yd^3 of material dredged per year disposed at ODMDS's over the last 10 years. Quantities may decrease slightly as more beneficial uses of dredged material onshore are identified. The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention), to which the U.S. is a signatory, requires annual reporting of the amount of materials disposed at sea. The COE prepares the dredged material disposed portion of the report to the International Maritime Organization, the yearly reports for which are posted on COE's Ocean Disposal Database (U.S. Dept. of the Army, COE, 2011b).

OCS Sand Borrowing

Chapter 4.1.3.2.2 of the Multisale EIS discusses in detail this Agency's Marine Minerals Program, which provides policy direction for the development of marine mineral resources on the OCS. If OCS sand is desired for coastal restoration or beach nourishment, BOEMRE uses the following two types of lease conveyances: a noncompetitive negotiated agreement that can only be used for obtaining sand and gavel for public works projects funded in part or whole by a Federal, State, or local government agency; and a competitive lease sale in which any qualified person may submit a bid. The BOEMRE has issued 29 noncompetitive negotiated agreements but it has never had a competitive lease sale for OCS sand and gravel resources. The OCS Program continues to focus on identifying sand resources for coastal restoration, investigating the environmental implications of using those resources, and processing noncompetitive use requests.

This Agency has participated in the multi-agency Louisiana Sand Management Working Group since 2003 to identify, prioritize, and define a pathway for accessing sand resources in the near-offshore OCS of Louisiana, an area where competitive space use mainly involves OCS oil and gas infrastructure such as wells, platforms, and pipelines. **Table 3-14** shows the projected OCS sand uses for coastal restoration projects over approximately the next 5 years. Approximately 76 million yd^3 are expected to be needed for coastal restoration projects as reported by the GOM OCS Region's Coastal Impact Assistance Program Office. To visualize such a dimension, it is equivalent to a volume of sand that could fit on a National Football League field (300 x 160 ft) to a height of 2.71 mi (4.3 km) high.

This Agency received earmarked funds in 2005 to conduct offshore sand studies to investigate available sources of OCS sand for restoring coastal areas in Louisiana, Texas, Alabama, and Mississippi that were damaged by Hurricanes Katrina and Rita. Sand sources identified through this Agency's cooperative effort with Louisiana will likely serve as the major source of material for the restoration of the barrier islands planned as part of the LCA ecosystem restoration study (U.S. Dept. of the Army, COE, 2004b). The Louisiana Office of Coastal Protection and Restoration and Louisiana State University have undertaken joint efforts, funded in part through BOEMRE, to identify potential sand resources in the Trinity and Tiger Shoal complex, located in the Vermilion and South Marsh Island leasing areas, and to examine the long-term effects of dredging sand on Ship Shoal, a large potential borrow area about 15 mi (24 km) offshore Isle Dernieres, south central Louisiana. Meanwhile, the General Lands Office in Texas is collecting new geologic and geophysical data to describe potential resources in buried Pleistocene Sabine and Colorado River paleochannels, located offshore Jefferson and Brazoria Counties.

Since the dredging of OCS sand and the associated activities of oceangoing dredge vessels could present some use conflicts on blocks also leased for oil and/gas extraction, this Agency initiated a regional offshore sand management program in Louisiana in 2003, which over the course of 4 years and several meetings has developed options and recommendations for an orderly process to manage the competing use of OCS sand resources in areas of existing OCS infrastructure. With input from the Sand Management Working Group, BOEMRE has developed guidelines for sand resource allocations, maintaining a master schedule of potential sand dredging projects, developing procedures for accessing sand under emergency conditions, and establishing environmental requirements for the use of offshore borrow areas.

No sand leases have ever been issued for OCS sand in the WPA. The following five leases for OCS sand have been issued in the CPA: (1) Holly Beach, Cameron Parish, Louisiana; (2) the South Pelto test area, Terrebonne Parish, Louisiana; (3) Chaland Pass shoreline restoration, Plaquemines Parish, Louisiana; (4) Raccoon Island marsh creation, Terrebonne Parish, Louisiana; and (5) St. Bernard Shoals, St. Bernard and Plaquemines Parishes, Louisiana.

Cumulative Activities Scenario: The BOEMRE anticipates that, over the next 40 years, no OCS sand borrowing projects would be anticipated in the WPA. The boundary between the OCS and Texas State waters (9 nmi [10 mi; 16 km]) allows that most accessible offshore sand is within the jurisdiction of the State so that OCS sand will not be necessary. Great uncertainty exists for how much OCS sand offshore the State of Louisiana will eventually be sought. The CWPPRA projects that are authorized may seek to access it, but it is not entirely clear how coordination between the State and Federal authorities is undertaken in order to develop the range of projects selected for the State's Coastal Protection and Restoration Authority's Annual Plan and the coastal restoration and flood protection projects that are part of COE's plan (U.S. Dept. of the Army, COE, 2009b, Figures 17-1, 17-2, and 17-3).

Marine Transportation

Chapter 4.1.3.2.3 of the Multisale EIS and Chapter 3.3.3 of the 2009-2012 Supplemental EIS discuss the extensive maritime industry that exists in the northern GOM. Freight and cruise ship passenger marine transportation within the analysis area should continue to grow at a modest rate or remain relatively unchanged based on historical freight traffic statistics under current conditions. The Port of New Orleans was the sixth largest port in the United States in terms of tonnage handled in 2008. Tankers carrying mostly petrochemicals account for about 40 percent of the vessel calls. Dry-bulk vessels carrying coal, coke, grain, etc., account for another 40 percent of vessel calls. New Orleans is a popular port for cruises. The Port of New Orleans supports year-round operations at the Julia Street and Erato Street cruise terminals that, in 2009 and 2010, saw 101 and 89 cruise ship departures, respectively (USDOT, MARAD, 2011).

Trends for use of all Gulf Coast ports show an increase from 31.2 to 34.1 percent of total U.S. port use (USDOT, MARAD, 2009) between 2004 and 2009 (**Table 3-15**), an increase of about 3 percent over the past decade. The estimated number of vessel trips that would occur as a result of the WPA proposed action is presented in **Table 3-2**. Use by the OCS Program represents a small percentage of total marine transportation in the GOM, <1 percent of reported usage for Federal channels (**Chapter 3.1.1.4.4**).

Cumulative Activities Scenario: The BOEMRE anticipates that, over the next 40 years, the total amount of Gulf Coast port usage will be bounded by a lower limit of the approximate levels of current use and a higher limit consisting of a steady increase of approximately 3 percent each decade.

Military Activities

Chapter 4.1.3.2.4 of the Multisale EIS and Chapter 3.3.3 of the 2009-2012 Supplemental EIS discuss in detail the extensive use of the offshore GOM for military activities. The WPA includes all or parts of the following military warning areas: W-147, W-228, and W-602.

The air space over the WPA is used by the DOD for conducting various air-to-air and air-to-surface operations. Twelve military warning areas and six Eglin Water Test Areas are located within the Gulf (**Figure 2-3**). These warning and water test areas are multiple-use areas where military operations and oil and gas development have coexisted without conflict for many years. Several military stipulations are planned for leases issued within identified military areas.

Cumulative Activities Scenario: The BOEMRE anticipates that, over the next 40 years, the military use areas currently designated in the WPA will remain the same and that none of them would be released for nonmilitary use. Over the cumulative activities scenario, BOEMRE expects to continue to require military coordination stipulations in these areas. The intensity of the military's use of these areas, or the type of activities conducted in them, is anticipated to fluctuate with the military mission needs.

Artificial Reefs and Rigs-to-Reefs Development

Chapter 4.1.3.2.5 and Appendix A.4 of the Multisale EIS and Chapter 3.3.3 of the 2009-2012 Supplemental EIS discuss in detail artificial reefs and rigs-to-reefs development in the GOM. Artificial reefs have been used along the coastline of the U.S. since the early 19th century. Stone (1974) documented that the use of obsolete materials to create artificial reefs has provided valuable habitat for numerous species of fish in areas devoid of natural hard bottom. Stone et al. (1979) found reefs in marine waters not only attract fish, but in some instances also enhance the production of fish. All of the five Gulf Coast States—Texas, Louisiana, Mississippi, Alabama, and Florida—have artificial reef programs and plans.

Most OCS platforms have the potential to serve as artificial reefs. Offshore oil and gas platforms began providing artificial reef substrate in the GOM with the first platform's installation in 1942. Historically, approximately 9 percent of the platforms decommissioned in the Gulf OCS have been used in the Rigs-to-Reefs Program. It is anticipated that approximately 10 percent of platforms installed as a result of the WPA proposed action would be converted to a reef after decommissioning. This factor is prompting increased public attention on the ecologic value of oil and gas structures for their reef effects. Ongoing studies aim at evaluating the ecology of offshore structures and may lead to a greater emphasis on creation of artificial reefs through the Rigs-to-Reefs Program. At present, Texas, Louisiana, and Mississippi participate in the Rigs-to-Reefs Program.

WPA Proposed Action Scenario: The number of platforms projected for the proposed action in the WPA is 19-33 (**Table 3-2**). The number of rigs-to-reefs anticipated as a result of the WPA proposed action is approximately 10 percent of the projected removals, or 2-3 in the WPA.

OCS Program Scenario: For the OCS Program from the years 2007-2046, a total of 1,072-1,148 platforms in the WPA are projected to be removed during the 40-year cumulative activities scenario (Table 4-4 of the Multisale EIS). If approximately 10 percent of these structures are accepted into the Rigs-to-Reefs Program, there may be as many as 107-114 additional artificial reefs installed in the WPA or elsewhere.

Offshore Liquefied Natural Gas Projects and Deepwater Ports

Chapter 4.1.3.2.6 of the Multisale EIS discusses in detail offshore LNG terminals projected, approved, and existing in the GOM. One LNG terminal is presently operating on the OCS in the GOM: the Gulf Gateway Energy Bridge. Brought into service in March 2005, the Gulf Gateway Energy Bridge is located in 280 ft (85.3 m) of water in West Cameron, South Addition Block 603, approximately 116 mi (187 km) offshore the Texas-Louisiana border. The Gulf Gateway Energy Bridge is capable of delivering natural gas at a baseload rate of 500 Bcf per day. The license for the Gulf Gateway Energy Bridge operation was issued by DOT's Maritime Administration (MARAD) on May 24, 2004.

Exxon-Mobile's Golden Pass LNG terminal on the Sabine Pass waterway in Jefferson County near the Texas-Louisiana border and Port Arthur, Texas, was scheduled to open in 2009, but it was severely damaged by Hurricane Ike in September 2008. At full operation, Golden Pass will be able to deliver the equivalent of 2 Bcf per day of natural gas. Golden Pass received its first shipment of super-cooled LNG on October 28, 2010, at which time (Gonzalez, 2010) reported that it arrived in the midst of a domestic gas surplus.

"Shale gas" is a new source of onshore natural gas that is easy to reach, and it is throwing plans for LNG terminals into turmoil. Recent technological improvement in hydraulic fracturing tight geologic formations has opened the shale gas frontier. Shale gas is held in fine-grain formations, such as shale, that is difficult to produce without introducing artificial fractures (fracking) through which gas can flow to a wellbore and be produced. The prospect of a larger, more accessible, domestic gas supply acts to depress gas prices and affects the economics for heavily capitalized LNG installations. The Henry Hub price of natural gas between 2002 and 2007 fluctuated between $5.00 and $8.00 Mcf. The price spiked to $15.00 Mcf after the 2005 GOM hurricanes, and a speculative bubble peak high price of $13.00 Mcf was reached in July 2008. With aggressive discovery and production of shale gas and the Great Recession, the Henry Hub price of natural gas in 2009 and 2010 collapsed to fluctuate between $2.00 and $5.00 Mcf for most of this period. The LNG or deepwater port facilities below are now in some stage of the permitting process (USDOT, MARAD, 2010).

Louisiana

Main Pass Energy Hub. Freeport McMoRan filed a notice of revised application on June 22, 2006, to convert a sulphur/brine mining facility into an LNG terminal for regasification. An EIS was prepared and the Governor of Louisiana issued an approval letter on November 20, 2007. The Main Pass Energy Hub would be located 16 mi (26 km) offshore Louisiana in Main Pass Block 299. As of May 27, 2009, the Federal Energy Regulatory Commission granted a 1-year extension to Freeport McMoRan to build a pipeline associated with the facility, and Freeport McMoRan is in the process of seeking gas suppliers.

Texas

Texas Offshore Port System. On December 8, 2008, the Texas Offshore Port System project filed an application with MARAD seeking approval to build, own, and operate a deepwater port facility for crude oil 30 mi (48 km) southeast of Freeport, Texas, in the GOM. If approved and constructed as planned, the deepwater port should be capable of importing 1.7 million bbl of oil/day into the U.S. and should also facilitate delivery of the waterborne crude to refining centers along the Texas Gulf Coast.

On January 5, 2009, the application was deemed complete, and on January 9, 2009, a Notice of Application was published in the *Federal Register*. Public scoping meetings were held in mid-February 2009 and the comments received were evaluated by MARAD and USCG. On March 13, 2009, MARAD and USCG issued a letter to the Texas Offshore Port System that suspended application processing because of the need for additional environmental and financial data. The applicant is currently in the process of gathering the required information and addressing the identified data gaps. On April 21, 2009, two of the three companies composing the Texas Offshore Port System partnership formally announced their dissociation, or exit, from the proposed project. However, the remaining company has agreed to continue the Texas Offshore Port System project. The MARAD is reviewing information sent by the applicant in order to resolve the data gaps necessary to process the application.

Cumulative Activities Scenario: The economic viability and enthusiasm for LNG facilities over the cumulative activities scenario is expected to decrease over at least the next decade, and perhaps stabilize after that. It is possible that LNG facilities in the GOM or elsewhere now in the permitting process or construction phases could be withdrawn from consideration, cancelled, or deferred until LNG economics improve or until facilities under construction for importing LNG could be modified for exporting LNG. The BOEMRE anticipates that, over the next 40 years, two additional LNG facilities in the CPA and a deepwater port in the WPA would be licensed and operating in the cumulative impacts area. Short summaries for the following pending applications for facilities in the cumulative impact area can be found at the MARAD website (USDOT, MARAD, 2010).

Development of Gas Hydrates

The DOE and cooperating agencies are in the middle of a multiyear characterization program of naturally occurring methane hydrates (gas hydrates) in the GOM. The first cruise for characterizing GOM gas hydrates took place in 2005, and the second took place in 2009. A third cruise is in the planning stages. Gas hydrates are a unique, energy-rich, and poorly understood class of chemical substances in which molecules of one material (in this case solid-state water ─ ice) form an open lattice that physically encloses molecules of a certain size (in this case ─ methane) in a cage-like structure without chemical bonding (Berecz and Balla-Achs, 1983; Henriet and Mienert, 1998; Collett, 2002). Studying gas hydrates poses unique technical challenges because they occur only in remote and mechanically challenging environments ─ arctic landmasses and deepwater continental shelves. Moreover, they are only stable in high-pressure and low-temperature environments, and they are difficult to extract from their natural setting for laboratory study.

The Methane Hydrate Research and Development Act of 2000 (P.L. 106-193; May 2, 2000) promoted the research, identification, assessment, exploration, and development of methane hydrate resources in the United States as the work of a joint effort between seven Federal agencies. The DOE is the coordinating agency and participants include the USGS, this Agency, BLM, the Naval Research Laboratory, NOAA, and the National Science Foundation. The Methane Hydrate Research and Development Act of 2000 was reauthorized for 2005-2010 in Section 968 of EPAct.

The Methane Hydrate Research and Development Act of 2000 allows DOE to enter into awards, contracts, and cooperative agreements with institutions of higher education or industrial enterprises for the purposes of (1) conducting basic and applied research to identify, explore, assess, and develop methane hydrate as a source of energy; (2) developing technologies required for efficient and environmentally sound development of methane hydrate resources; (3) undertaking research programs to provide safe means of transport and storage of methane produced from gas hydrates; (4) promoting education and training in methane hydrate resource research and resource development; (5) conducting basic and applied research to assess and mitigate the environmental impacts of hydrate degassing (including both natural degassing and degassing associated with commercial development); (6) developing technologies to reduce the risks of drilling through naturally occurring methane hydrates; and (7) drilling in support of authorized activities.

Seismic evidence for gas hydrates typically consists of a bottom simulating reflector at relatively shallow depths below mudline; shallow at least in comparison with conventional oil and gas exploration wells. The bottom simulating reflector is caused by the large acoustic impedance contrast at the base of the gas hydrate stability zone that separates sediments containing gas hydrate above with sediments containing free gas below.

In the Gulf of Mexico a Joint Industry Project (JIP) was formed to carry out an assessment of gas hydrates. Members of the 2009 JIP included ChevronTexaco (operator); this Agency; ConocoPhillips; Halliburton; Total; Schlumberger; Reliance Industries Limited; Japanese Oil, Gas, and Metals National Corporation; Korea National Oil Company; and StatoilHydro. Three legs to the total JIP were planned. For the first leg in 2005, JIP carried out a test drilling program to sample gas hydrates on the Gulf of Mexico OCS at eight locations in three blocks (Atwater Valley Blocks 13 and 14, and Keathley Canyon Block 151) in the CPA where hydrates were thought to occur. The results of the 2005 JIP were published in the DOE newsletter *Fire in the Ice* (Birchwood et al., 2008).

For the second leg in 2009, JIP was permitted by this Agency to carry out a test drilling program to sample gas hydrates on the Gulf of Mexico OCS at multiple locations in two blocks; Green Canyon Block 955 and Walker Ridge Block 313 in the CPA and Alaminos Canyon Blocks 775, 818, and 819 in the WPA. The JIP modified the WPA drilling program to include two boreholes in Alaminos Canyon Block 21 instead of the originally permitted blocks (Fire in the Ice, 2009) and deployed for Leg II in April 2009 using a dynamically-positioned drillship. The test wells were 8.5-in-diameter that penetrated shallow sediment up to 3,680 ft (1,122 m) below mudline to allow geophysical logging followed by abandonment procedures. All wells were geophysically logged while drilling with resistivity, borehole imaging, gamma ray, density, neutron porosity, and magnetic resonance logs. Unlike the 2005 JIP program in the GOM, the 2009 JIP did not retrieve pressurized cores of gas hydrate from the sampled holes. Technical reports resulting from the 2009 JIP include Boswell et al. (2009), Kou (2010), and Zhang and McConnell (2011).

This Agency released the results of a systematic geological and statistical assessment of gas hydrates resources in the GOM (USDOI, MMS, 2008b). This assessment incorporates the latest science with regard to the geological and geochemical controls on gas hydrate occurrence. It indicated that a mean volume of 607 trillion m^3 (21,444 Tcf) of methane was in-place in hydrate form. The assessment has determined that a mean of 190 trillion m^3 (6,710 Tcf) of this resource occurs as relatively high-concentration accumulations within sand reservoirs that may some day be produced. The remainder occurs within clay-dominated sediments from which methane probably would never be economically or technically recoverable.

Cumulative Activities Scenario: The BOEMRE anticipates that, over the next 40 years, JIP will complete the third leg of their characterization project for GOM gas hydrates in the cumulative impacts area. Within 40 years, it is likely that the first U.S. domestic production from hydrates may occur in Alaska, where gas obtained from onshore hydrates will either support local oil and gas field operations or be available for commercial sale if and when a gas pipeline is constructed to the lower 48 states. However, Moridis et al. (2008, p. 4) stated that it is not possible to discount the possibility that first U.S. domestic production of gas hydrates could occur in the GOM. Despite the substantially increased complexity and cost of offshore operations, there is a mature network of available pipeline capacity and easier access to markets in the GOM.

Renewable Energy and Alternative Use

Chapter 4.1.3.3.5 of the Multisale EIS and Chapter 3.3.6 of the 2009-2012 Supplemental EIS discuss the renewable (sometimes called “alternative”) energy projects as they are developing in the GOM. On August 8, 2005, President George W. Bush signed EPAct into law. Section 388 (a) of EPAct amended Section 8 of the OCSLA (43 U.S.C. 1337) to authorize DOI to grant leases, easements, or rights-of-way on the OCS for the development and support of energy resources other than oil and gas and to allow for alternate uses of existing structures on OCS lands.

A final programmatic EIS for the OCS renewable energy program was published by this Agency in October 2007 (USDOI, MMS, 2007e) and a Record of Decision was published in the *Federal Register* on January 10, 2008 (*Federal Register*, 2008). The Act authorized this Agency to develop a comprehensive program and regulations to implement the new authority. Final rules for the renewable energy program were published on April 29, 2009, as 30 CFR 285 (*Federal Registe*r, 2009b).

The two primary categories of renewable energy that have potential for development in the coastal and OCS waters of the U.S. are (1) wind turbines and (2) marine hydrokinetic systems. The first and most technologically mature renewable energy is wind energy, a popular source of clean and renewable energy that has been in use for centuries. At present, 45 offshore wind farms are in operation off the coasts of the United Kingdom and mainland Europe in waters generally shallower than 30 m (100 ft), and 10 more offshore wind farms are currently under construction there (European Wind Energy Association, 2011). China and Japan also have offshore wind farms and plan to expand their offshore wind power (Feldman, 2009; Schwartz, 2010; Singh, 2010; offshoreWIND.biz, 2010).

Ocean wind energy has emerged as a promising renewable energy resource for a number of reasons: (1) the strength and consistency of winds on the ocean are roughly proportional to distance from shore, the farther from shore the stronger and more persistent; (2) offshore wind generating facilities (wind parks) can therefore be located in proximity to major load centers in the energy-constrained northeastern U.S.; (3) long-term potential for the over-the-horizon siting and undersea transmission lines counters the aesthetics and land-use concerns associated with onshore wind installations and those that can be seen easily from shore; and (4) as a fuel, wind is both cost-free and emission free (Massachusetts Technology Collaborative, 2005).

The DOE released a predecisional strategic plan for creating an offshore wind industry in the U.S. (USDOE, 2010). In this plan, DOE determined that offshore wind energy can help the Nation reduce its greenhouse gas emissions, diversify its energy supply, provide cost-competitive electricity to key coastal regions, and stimulate economic revitalization of key sectors of the economy. However, if the Nation is to realize these benefits, key barriers to the development and deployment of offshore wind technology must be overcome, including the relatively high cost of energy, technical challenges surrounding installation and grid interconnection, and the untested permitting processes governing deployment in both Federal and State waters. There are two critical objectives to realize the strategic plan’s goals: (1) reduce the cost of offshore wind energy; and (2) reduce the timeline for deploying offshore wind energy (USDOE, 2010, p. 1). Since April 29, 2009, when the regulations governing renewable energy on the OCS were promulgated, no wind park developments have been proposed in OCS waters of the GOM; however, there have been proposals in Texas coastal waters.

The second category of offshore renewable energy is marine hydrokinetic systems, which are in a more developmental stage relative to wind turbines. The marine hydrokinetic systems consist of devices capable of capturing energy from ocean waves and currents. There has been no interest expressed in wave or current technologies in the GOM because the conditions necessary for their deployment are not suitable to the Gulf. The marine hydrokinetic current technologies are actively being considered for the east coast of Florida where the Gulf Stream provides a strong and continuous source of energy to turn underwater turbines.

The EPAct clarifies the Secretary's authority to allow the existing oil and gas structures on OCS lands to remain in place after production activities have ceased and to transfer liability and extend the life of these facilities for non-oil and gas purposes, such as research, renewable energy production, aquaculture, etc., before being removed. With approximately 1,900 bottom-founded platform structures located in OCS waters, the GOM would seem to have some potential for the reuse of these facilities. Although BOEMRE has had conversations with developers about conceptual ideas for alternative use projects, no developer has stepped forward with an application to actualize one.

Cumulative Activities Scenario: The BOEMRE anticipates that, over the next 40 years, at least one alternative use project would be brought to this Agency for action in the area off Texas. It is also likely that at least one wind park project, in addition to the known projects in Texas waters, will be proposed offshore Louisiana in the cumulative impact area. A project could consist of a combination of integrated existing GOM infrastructure with new-built facilities. Such a projection is made because this type of project was vetted to this Agency in 2004, before EPAct was passed to set up the framework to permit and regulate renewable energy projects on the OCS.

Renewable Energy Projects in Texas State Waters

On October 24, 2005, the Texas General Land Office announced authorization for the first offshore wind energy project in the United States to be built in State waters off the Texas coast. An 11,355-ac (4,595-ha) lease was awarded to Galveston-Offshore Wind, L.L.C., a subsidiary of Louisiana-based Wind Energy Systems Technologies. The lease allows work to begin immediately on the construction of two meteorological towers to gather wind resource data to determine exactly where 50 wind turbines would be placed for the150-megawatt development. The lease area is located approximately 7 mi (11 km) southeast of Galveston Island in Texas Blocks 187 and 188. State waters in Texas, unlike the other states, extends 3 leagues (10.3 mi; 16.5 km) offshore, an artifact of Texas having been admitted to the Union as an independent country in 1845. In October 2007, the Texas General Land Office held a competitive auction for four additional offshore wind lease sites in State waters. Wind Energy Systems Technologies won the competition and was awarded the rights for these additional leases south of the Galveston-Offshore Wind, L.L.C. project area and, which would be developed after the Galveston project.

Wind Energy Systems Technologies has agreed to a three-phase lease agreement for development of the Galveston lease area. During phase 1, Wind Energy Systems Technologies will spend $3-$5 million to build and operate two, 80-m-tall (262-ft) meteorological towers designed to collect wind data in the GOM. Wind Energy Systems Technologies will also pay the State a lease rent of $10,000 a year until actual wind energy production begins. Concurrently, studies of bird migration patterns will be done and information required for State and Federal permits will be gathered.

Once the characterization Phase 1 is complete, Phase 2 involves construction that is expected to cost as much as $300 million and could take as long as 5 years. Phase 3 is a 30-year operating period over which time the developer would pay into the Texas Permanent School Fund through the Texas General Land Office at graduated rates over time.

3.3.4. Other Major Factors Influencing Coastal Environments

Natural and man-caused factors influence the coastal areas of the Gulf States while OCS activity takes place at the same time. Some of these factors are (1) sea-level rise and subsidence; (2) Mississippi

Delta hydromodifications; (3) maintenance dredging activities; (4) Coastal Impact Assistance Program activities; and (5) coastal restoration programs.

Sea-Level Rise and Subsidence

Chapter 4.1.3.3.1 of the Multisale EIS and Chapter 3.3.4 of the 2009-2012 Supplemental EIS discuss wetland submergence in the LCA. The Delta Plain and Chenier Plain of the LCA are experiencing relatively high subsidence rates as part of the Mississippi River's delta system. All coastlines of the world have been experiencing a gradual absolute rise of sea level that is based on measurements across the globe and that extends across the influence of a single sedimentary basin. There are two aspects of sea-level rise during the most geologically recent 10,000 years (Holocene Epoch): absolute rise and relative rise. Absolute sea-level rise refers to a net increase in the volume of water in the world's oceans. Relative sea-level rise refers to the appearance of sea-level rise, a circumstance where subsidence of the land is taking place at the same time that an absolute sea-level change may be occurring. Geologists tend to consider all sea-level rise as relative because the influence of one or the other is difficult to separate over geologic time frames.

An absolute sea-level rise would be caused by the following two main contributors to the volume of ocean water on the Earth's surface: (1) change in the volume of ocean water based on temperature; and (2) change in the amount of ice locked in glaciers, mountain ice caps, and the polar ice sheets. For the period 1961-2003, thermal expansion of the oceans accounts for only 23 ± 9 percent of the observed rate of sea-level rise (Intergovernmental Panel on Climate Change, 2007, Chapter 5 and Table 5.3), the remainder is water added to the oceans by melting glaciers, ice caps, and the polar ice sheets. The contribution of thermal expansion is between 14 and 32 percent of the total absolute sea level rise over this 42-year period. The remainder, approximately 75 percent, of sea-level rise is attributed to melt water.

Measurement of sea-level rise over the last century is based on tidal gauges and, more recently, satellite observations, that are not model-dependent. Projections for future sea-level rise are dependent on temperature. As determined by analysis of air bubbles trapped in Antarctic ice cores, today's atmospheric concentration of CO_2 is the highest it has ever been over the last 800,000 years (Karl et al., 2009, p. 13). Although the measured data for atmospheric CO_2 concentration or temperatures measurements since the Industrial Revolution are generally not in dispute, proxy data for climates of the geologic past are a source of debate and the models constructed to make projections for how climate may change remain controversial. Climate models are very sophisticated, but they may not account for all variables that are important or may not assign to modeled variables the weight of their true influence.

The Intergovernmental Panel on Climate Change reported that, since 1961, global average sea level (mean sea level) has risen at an average rate of 1.8 millimeter/year (mm/yr) (0.07 in/yr) and, since 1993, at 3.1 mm/yr (0.12 in/yr) (Intergovernmental Panel on Climate Change, 2007). Whether the faster rate for 1993-2003 reflects decadal variability or an increase in the longer-term trend is unclear. In the structured context used by the Intergovernmental Panel on Climate Change, there is high confidence that the observed sea-level rise rate increased from the 19th to the 20th century. The average global rate for the 20th century was determined by Bindoff et al. (2007, Section 5.5.2.1) to be 1.7 ± 0.5 mm/yr and the total 20th-century average rise is estimated to be 0.17 m (0.55 ft) (Intergovernmental Panel on Climate Change, 2007). The U.S. Global Change Research Program reported that over the last 50 years sea-level has risen up to 8 in (203 mm) along parts of the Atlantic and Gulf Coasts that included Louisiana and Texas (Karl et al., 2009, p. 37), and that global sea level is currently rising at an increasing rate.

Although absolute sea-level rise is a contributor to the total amount of sea-level rise along the Gulf Coast, subsidence is the most important contributor to the total. In comparison to other areas along the Gulf Coast, Louisiana's Mississippi Delta and Chenier Plains are built of young sediments deposited over the last 7,000 years. These deltaic sediments have been undergoing compaction and subsidence since they were deposited. The land is sinking at the same time that sea level is rising, contributing to high rates of relative sea-level rise along the Louisiana coast. Blum and Roberts (2009) posited three scenarios for subsidence and sea-level rise, and they concluded sediment starvation alone would cause ~2,286 mi^2 (592,071 ha) of the modern delta plain to submerge by 2050, without any other impacting factors contributing to landloss.

A general value of ~6 mm/yr (0.23 in) of subsidence from sediment compaction, dewatering and oxidation of organic matter (Meckel et al., 2006; Dokka, 2006) is a reasonable rate to attribute to the

Louisiana coastal area, with the understanding that subsidence rates along the Louisiana coast are spatially variable and influenced by subsurface structure and the timing and manner that the delta was deposited. Applied to the entire coast, it is an oversimplification of a complex system, but it is an estimate that is reasonable based on recent data.

Stephens (2009 and 2010a) reported that the influence of subsurface structure has not been taken into account in subsidence assessments in the LCA and along the Gulf Coast (Stephens, 2009, p. 747). Most workers studying the affects of subsidence along the LCA have focused on surficial or near-surface geologic data sources and have made no attempt to integrate basin analysis into planning for coastal restoration or flood control project planning.

The BOEMRE anticipates that, over the next 40 years, the LCA will likely experience a total of relative sea-level rise of ~45 cm (18 in), or approximately 9 mm/yr (0.35 in). This estimate is made by combining the estimated rate for subsidence (~6 mm/yr) (0.23 in) and the estimated rate for absolute sea-level rise (~3 mm/yr) (0.12 in).

Formation Extraction and Subsidence

Extracting fluids and gas from geologic formations can lead to localized subsidence at the surface. The Texas Gulf of Mexico coast is experiencing high (5-11 mm/yr) (0.19-0,43 in) rates of relative sea-level rise that are the sum of subsidence and eustatic sea-level rise (Sharp and Hill, 1995) Even higher rates are associated with areas of groundwater pumping from confined aquifers. Berman (2005, Figure 3) reported that 2 m (6 ft) of subsidence has occurred in the vicinity of the Houston Ship Channel by the mid-1970s as a result of groundwater withdrawal.

Morton et al. (2005) examined localized areas or "hot spots" corresponding to fields in the LCA where oil, gas, and brine were extracted at known rates. Morton et al. (2005, Figure 26) shows measured subsidence along transects across these fields that range from 18 to 4 mm/yr (0.7 to 0.15 in), with the greatest rates tending to coincide with the surface footprints of oil or gas fields. Mallman and Zoback (2007) interpreted downhole pressure data in several Louisiana oil fields in Terrebonne Parish and found localized subsidence over the fields; however, they could not link these localized rates to the subsidence measured and observed on a regional scale.

Down-to-the-basin faulting, also called listric or growth faulting, is a long recognized structural style along deltaic coastlines, and the Mississippi Delta is no exception (Dokka et al., 2006; Gagliano, 2005a). There is currently disagreement in the literature regarding the primary cause of modern fault movement in the Mississippi Delta region, and the degree to which it is driven by fluid withdrawal or sediment compaction resulting from the sedimentary pile pressing down on soft, unconsolidated sediments that causes downward and toward the basin movement along surfaces of detachment in the shallow and deep subsurface.

Berman (2005) discussed the conclusions of Morton et al. (2005) and believed that they failed to make the case that hydrocarbon extraction caused substantial subsidence over the broader area of coastal Louisiana, a conclusion also reached by Gagliano (2005b).

Cumulative Activities Scenario: Oil production on the LCA peaked at 513 million bbl in 1970 and gas production peaked at 7.8 MMcf in 1969 (Ko and Day, 2004b). From peak the level of activity is slowly decreasing. The magnitude of subsidence caused by formation extraction is a function of how pervasive the activity is across the LCA. The oil and gas field maps in Turner and Cahoon (1988, Figure 4) and Ko and Day (2004b, Figure 1) seem an adequate basis to estimate the LCA's oil- and gas-field footprint at ~20 percent of the land area. The amount of subsidence from formation extraction is also occurring on a delta platform that is experiencing natural subsidence and sea-level rise. Fluid and gas extraction may lead to high local subsidence on the scale of individual oil and gas fields, but not as a pervasive contributor to regional subsidence across the LCA.

Mississippi River Hydromodification

Chapter 4.1.3.3.2 of the Multisale EIS and Chapter 3.3.4 of the 2009-2012 Supplemental EIS discuss river development and flood control projects on the Mississippi River. The Mississippi River has been anchored in place by engineered structures built in the 20th century and has been hydrologically isolated from the delta it built. The natural processes that allowed the river to flood and distribute alluvial sediments across the delta platform and channels to meander have been shut down. Hydromodifying interventions include construction of (1) levees along the river and distributary channel systems, (2) upstream dams and flood control structures that impound sediment and meter the river flow rate, and (3) channelized channels with earthen or armored banks. Once the natural processes that act to add sediment to the delta platform to keep it emergent are shut down, subsidence begins to outpace deposition of sediment.

Of total upstream-to-downstream flow, the Old River Control Structure (built 1963) diverts 70 percent of flow down the levee-confined channels of the Mississippi River and 30 percent down the unconfined Atchafalaya River, which has been actively aggrading its delta plain since 1973 (LaCoast.gov, 2011). Blum and Roberts reported that the time-averaged sediment load carried by the Mississippi and Atchafalaya Rivers pre-Old River Control Structure was ~400-500 million tons per year and that the average suspended load available to either river after the Old River Control Structure was ~205 million tons per year (Blum and Roberts, 2009, Figure 2). Modern sediment loads are, therefore, less than half that required to build and maintain the modern delta plain, a figure largely in agreement with previous work reporting decreases in suspended sediment load of nearly 60 percent since the 1950's (Turner and Cahoon, 1987, Figure 3-8; Tuttle and Combe, 1981).

Blum and Roberts (2009, Figure 3b) posited three scenarios for subsidence and sea-level rise, and concluded sediment starvation alone would cause ~2,286 mi^2 (592,071 ha) of the modern delta plain to submerge by 2050 without any other impacting factors contributing to landloss. The use of sediment budget modeling, a relatively new tool for landloss assessment, appears to indicate that hydrographic modification of the Mississippi River has been the most profound man-caused influence on landloss in the LCA. Sediment starvation of the deltaic system is allowing rising sea level and subsidence to outpace the constructive processes building and maintaining the delta.

Cumulative Activities Scenario: The BOEMRE anticipates that, over the next 40 years, there might be minor sediment additions resulting from new and continuing freshwater diversion projects managed by COE. Of the 179 projects in the CWPPRA program (LaCoast.gov, 2010a), 27 involve introduction of sediment or reestablishment of natural water and sediment flow regimes to allow the delta plain to replenish and build up 10 are freshwater diversion projects, 5 are outfall management, 1 is sediment diversion, and 16 are marsh creations. Insofar as these projects represent land additions to the LCA, they are already accounted for in the discussion below under coastal restoration programs.

Maintenance Dredging and Federal Channels

Chapter 4.1.3.3.3 of the Multisale EIS and Chapter 3.3.4 of the 2009-2012 Supplemental EIS discuss maintenance dredging.

Along the Texas Gulf Coast there are eight federally maintained navigation channels in addition to the GIWW. Most of the dredged materials from the Texas channels have high concentrations of silt and clay. Beneficial uses of dredged material include beach nourishment for the more sandy materials, and storm reduction projects or ocean disposal for much of the finer-gained material. Ocean disposal locations along the Texas coast are situated so that materials are placed on the down drift side of the channel (U.S. Dept. of the Army, COE, 1992, p. 56).

Maintenance dredging activity since 2000 for Federal channel by the Galveston District of the Corps of Engineers are reported in COE's Ocean Disposal Database (U.S. Dept. of the Army, COE, 2011b) (**Table 3-16**).

There are 10 Federal navigation channels in the LCA, ranging in depth from 4 to 14 m (12 to 45 ft) and in width from 38 to 300 m (125 and 1,000 ft) that were constructed as public works projects beginning in the 1800's (Good et al., 1995, Table 1). The combined length of the Federal channels in Good et al. was reported as 2,575 mi (1,600 km) with three canals considered deep-draft and seven as shallow (Good et al., 1995, p. 9). The Multisale EIS (USDOI, MMS, 2007b, p. 4-316) reported 1,243 mi (2,000 km) of OCS-related navigation channels. The Federal navigation channels in Louisiana identified by Good et al. (1995, Table 1) are as follows: (1) GIWW East of Mississippi River; (2) Mississippi River Gulf Outlet; (3) GIWW between the Atchafalaya and Mississippi Rivers; (4) GIWW West of Atchafalaya River; (5) Barataria Bay Waterway; (6) Bayou Lafourche; (7) Houma Navigation Canal; (8) Mermentau Navigation Channel; (9) Freshwater Bayou; and (10) Calcasieu River Ship Channel.

Turner and Cahoon (1987, Table 4-1) and DOI (USDOI, MMS, 2007b, Table 3-36) identified OCS-related channels that bore traffic supporting the OCS Program. Between these works and Good et al.

(1995, Table 1) channel names do not well agree and a comparison is difficult. No channel is exclusively used by OCS Program traffic and only a fraction of total traffic is attributable to OCS use; approximately 12 percent (USDOI, MMS, 2007b, p. 4-316). The BOEMRE staff compiled **Table 3-17** using the information in industry plans to show that, between 2003 and 2008, the vast majority (80-90%) of OCS service vessels used service-base facilities in the LCA that are located along rivers or that lie within wetlands that are already saline or brackish. **Table 3-17** shows that the contribution of OCS Program traffic to bank degradation and freshwater wetland loss is minimal.

The GIWW is a Federal, shallow-draft navigation channel constructed to provide a domestic connection between Gulf ports after the discovery of oil in East Texas in the early 1900's, as well as the growing need for interstate transport of steel and other manufacturing materials. It extends approximately 1,400 mi (2,253 km) along the Gulf Coast from St. Marks in northwestern Florida to Brownsville, Texas, with the Louisiana part reported to be 994 mi (1,600 km) in length (Good et al., 1995, p. 9). With the exception of the east-west GIWW in Louisiana, Federal channels are sub-perpendicular with the GOM shoreline or saltwater bays, making them vulnerable to saltwater intrusion during storms.

Direct cumulative impacts include the displacement of wetlands by original channel excavation and disposal of the dredged material. Good et al. (1995, Table 1) estimated that direct impacts from the construction of Federal navigation channels were between 58,000 and 96,000 ac (23,472 and 38,850 ha). Indirect cumulative landlosses resulted from hydrologic modifications, saltwater intrusion, or bank erosion from vessel wakes (Wang, 1988). Once cut, navigation canals tend to widen as banks erode and subside, depending on the amount of traffic using the channel. Good et al. (1995, Table 1) estimated indirect impacts on wetland loss from bank erosion at 35,000 ac (14,164 ha).

The COE reported that the New Orleans District has the largest channel maintenance dredging program in the U.S., with an annual average of 70 million yd^3 of material dredged (U.S. Dept. of the Army, COE, 2009a, p. 26). Of that total, COE's Ocean Disposal Database indicates that about 16 million yd^3 were disposed at ODMDS sites by the New Orleans District (U.S. Dept. of the Army, COE, 2011a) (**Chapter 3.3.3**). Federal channels and canals are maintained throughout the onshore cumulative impact area by COE, State, county, commercial, and private interests. Proposals for new and maintenance dredging projects are reviewed by COE, State, and local agencies as well as by private and commercial interests to identify and mitigate adverse impacts upon social, economic, and environmental resources.

Maintenance dredging is performed on an as-needed basis. Typically, COE schedules surveys every 2 years on each navigation channel under its responsibility to determine the need for maintenance dredging. Dredging cycles may be from 1 to as many as 11 years from channel to channel and from channel segment to channel segment. The COE is charged with maintaining all larger navigation channels in the cumulative activities area. The COE dredges millions of cubic meters of material per year in the cumulative activities area, most of which is under the responsibility of the New Orleans District. Some shallower port-access channels may be deepened over the next 10 years to accommodate deeper draft vessels. Vessels that support deepwater OCS activities may include those with drafts to about 7 m (23 ft).

Construction and maintenance dredging of rivers, navigation channels, and pipeline access canals can furnish sediment for beneficial purpose, a practice the COE calls beneficial use of dredge materials program. Drilling, production activity, and maintenance at most coastal well sites in Louisiana require service access canals that undergo some degree of aperiodic maintenance dredging to maintain channel depth, although oil and gas production on State lands peaked in 1969-1970 (Ko and Day, 2004b, p. 398). In recent years, dredged materials have been sidecast to form new wetlands using the beneficial use of dredge materials program. Potential areas suited for beneficial use of dredged material are considered most feasible within a 10-mi (16-km) boundary around authorized navigation channels in the New Orleans District, but the potential for future long distance pipelines for disposal of dredged material could increase the potential area available for the beneficial use of dredge materials program considerably (U.S. Dept. of the Army, COE, 2009a, p. 27).

Current figures vary for how much of the average annual 70 million yd^3 (53,518,840 m^3) that is dredged by the New Orleans District is available for the beneficial use of dredge materials program: from 15 million yd^3 (11,468,320 m^3) (U.S. Dept. of the Army, COE, 2009a, p. 26) to 30 million yd^3 (22,936,650 m^3) (Green, 2006, p. 6), or between 21 and 43 percent of the total. The COE reported that, over the last 20 years, approximately 10,117 ha (25,000 ac) of wetlands have been created with dredged materials, most of which are located on the LCA delta plain (U.S. Dept. of the Army, COE, 2009b, p. 8).

Cumulative Activities Scenario: The construction of Federal channels is not a growth industry and at least one Louisiana channel (Mississippi River Gulf Outlet) has been decommissioned and sealed with a rock barrier as of July 2009 (Shaffer et al., 2009, p. 218). The DOI has used a widening rate for OCS-related channels of 1.5 m/yr (4.9 ft/yr) (USDOI, MMS, 2007b, p. 4-316). Using DOI's estimate of 2,000,000 m (1,243 mi) of OCS-related channel length (USDOI, MMS, 2007b, p. 4-316) and the estimated bank widening rate of 1.5 m/yr (5 ft/yr) for OCS-related channels, an annual landloss of ~741 ac/yr (300 ha/yr) may be estimated. During the 40-year cumulative activities scenario, landloss from indirect impacts on Federal navigation channels could be ~29,653 ac (12,000 ha). The use of Federal channels by OCS-related traffic is ~12 percent of total capacity, and an estimate may be made for the OCS Program's contribution to bank erosion over the 40 year cumulative scenario of 355 ha (877 ac).

The BOEMRE anticipates that, over the next 40 years, if current trends in use of dredged sand and sediment for the beneficial use of dredge materials program are simply projected based on past land additions and if there is no change in the average annual rate of wetland creation or protection with this program, approximately ~50,000 ac (20,234 ha) may be created or protected in the LCA. Subtracting projected land added from land lost, an estimated net landloss of ~9,419 ha (23,274 ac) between the years 2007-2046 could occur between land lost by bank degradation and channel widening and land added using the beneficial use of dredge materials program.

Coastal Restoration Programs

Chapter 4.1.3.3.4 of the Multisale EIS and Chapter 3.3.5 of the 2009-2012 Supplemental EIS discuss coastal restoration. The Mississippi Delta sits atop a pile of Mesozoic and Tertiary-aged sediments up to 7.5 mi (12.2 km) thick at the coast and it may be as much as 60,000 ft (18,288 m) or 11.4 mi (18.3 km) thick offshore (Gagliano, 1999). Five major lobes are generally recognized within about the uppermost 50 m (164 ft) of sediments (Britsch and Dunbar, 1993; Frazier, 1967, Figure 1). The oldest lobe contains peat deposits dated as 7,240 years old (Frazier, 1967, p. 296). The youngest delta lobe of the Mississippi Delta is the Plaquemines-Balize lobe that has been active since the St. Bernard lobe was abandoned about 1,000 years ago. The lower Mississippi River has shifted its course to the Gulf of Mexico every thousand years or so, seeking the most direct path to the sea while building a new deltaic lobe. Older lobes were abandoned to erosion and subsidence as the sediment supply was shut off. Because of the dynamics of delta building and abandonment, the Louisiana coastal area (U.S. Dept. of the Army, COE, 2004a) experiences relatively high rates of subsidence relative to more stable coastal areas eastward and westward.

The first systematic program authorized for coastal restoration in the LCA was the 1990 Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), otherwise known as the "Breaux Act." Individual CWPPRA projects are designed to protect and restore between 10 and 10,000 ac (4 and 4,047 ha), require an average of 5 years to transition from approval to construction, and are funded to operate for 20 years (U.S. Government Accountability Office, 2007, p. 2), a typical expectation for project effectiveness (Campbell et al., 2005, p. 245).

The 1990 CWPPRA introduced an ongoing program of relatively small projects to partially restore the coastal ecosystem. As the magnitude of Louisiana's coastal landlosses and ecosystem degradation became more apparent, so too appeared the need for a more systematic approach to integrate smaller projects with larger projects to restore natural geomorphic structures and processes. The Coast 2050 report (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1998) combined previous restoration planning efforts with new initiatives from private citizens, local governments, State and Federal agency personnel, and the scientific community to converge on a shared vision to sustain the coastal ecosystem. The LCA Ecosystem Restoration Study (U.S. Dept. of the Army, COE, 2004a) built upon the Coast 2050 Report. The LCA's restoration strategies generally fell into one of the following categories: (1) freshwater diversion; (2) marsh management; (3) hydrologic restoration; (4) sediment diversion; (5) vegetative planting; (6) beneficial use of dredge material; (7) barrier island restoration; (8) sediment/nutrient trapping; and (9) shoreline protection, as well as other types of projects (Louisiana Coastal Wetlands Conservation and Restoration Task Force, 2006, Table 1).

Following Hurricanes Katrina and Rita in 2005, an earlier emphasis on coastal or ecosystem restoration of the LCA was reordered to at least add an equal emphasis on hurricane flood protection. In late 2005, the Department of Defense Appropriations Act of 2006 authorized COE to develop a comprehensive hurricane protection analysis to present a full range of flood control, coastal restoration, and hurricane protection measures for south Louisiana (U.S. Dept. of the Army, COE, 2009c). The Appropriations Act required Louisiana to create a State organization to sponsor the hurricane protection and restoration projects that resulted. The State legislature established the Coastal Protection and Restoration Authority and charged it with coordinating the efforts of local, State, and Federal agencies to achieve long-term, integrated flood control and wetland restoration. The Coastal Protection and Restoration Authority produced a comprehensive master plan for a sustainable coast (State of Louisiana, 2007) as their vision of an integrated program of what had been separate areas of activity—flood protection and coastal restoration. The Coastal Protection and Restoration Authority's Annual Plans prioritize the types of projects undertaken each fiscal year. It is not entirely clear how coordination between the State and Federal authorities is undertaken in order to develop the range of projects selected for the State's Coastal Protection and Restoration Authority's Annual Plan and COE's plan (U.S. Dept. of the Army, COE, 2009a, Figures 17-1, 17-2, and 17-3).

The U.S. Government Accountability Office (GAO) recently audited the CWPPRA Program (U.S. Government Accountability Office, 2007). The GAO reported 74 completed CWPPRA projects between 1994 and 2007 that resulted in 58,781 "anticipated total acres" (23,788 ha) and 16 projects under construction as of mid-2007 that are reported to result in 20,860 anticipated total acres (8,442 ha) (U.S. Government Accountability Office, 2007, Tables 2 and 3). Of the 74 projects constructed since 1994, more than half were one of two types—shoreline protection or hydrologic restoration. Of the 179 CWPPRA priority projects listed on LaCoast.gov (2010b), 55 projects with 31,187 ac (12,621 ha) "total net acres" (defined as the sum of reestablished and protected acres present at the end of 20 years) are not found on GAO's completed or underway lists (U.S. Government Accountability Office, 2007, Tables 2 and 3), leading to a conclusion that these projects are in line for completion before 2019.

Cumulative Activities Scenario: The BOEMRE's anticipates that, over the next 40 years, ~12,621 ha (31,187 ac) of land would be added, or 316 ha/yr (781 ac/yr) between now and 2019. This estimate is based in the assumption that the full menu of 179 CWPPRA projects now anticipated (LaCoast.gov, 2010b) are completed by the end of the authorization period in 2019.

There is no simple way to anticipate what projects under the protection of the State's Coastal Protection and Restoration Authority are admitted to its Annual Plan and completed. There is also no simple way to anticipate what projects are undertaken for COE's comprehensive range of flood control, coastal restoration, and hurricane protection measures for the LCA will feed into the Coastal Protection and Restoration Authority's Annual Plan for authorization and which ones will be ultimately completed. Because these projects are chosen on the basis of annual appropriations, there is no simple way to establish projections for land added or preserved over the cumulative activities scenario.

Coastal Impact Assistance Program

The Energy Policy Act of 2005 was signed into law by President Bush on August 8, 2005. Section 384 of EPAct amended Section 31 of the OCSLA (43 U.S.C. 1356(a)) to establish the Coastal Impact Assistance Program (CIAP). The authority and responsibility for the management of CIAP is vested in the Secretary of the Interior; the Secretary delegated this authority and responsibility to this Agency. Under Section 384 of EPAct, this Agency was directed to disburse $250 million for each of the fiscal years (FY) 2007 through 2010 to eligible OCS oil- and gas-producing States and coastal political subdivisions (CPS's).

Eligible CIAP States	Eligible CIAP Coastal Political Subdivisions
Alabama	Baldwin and Mobile Counties
Alaska	Municipality of Anchorage and Bristol Bay, Kenai Peninsula, Kodiak Island, Lake and Peninsula, Matanuska-Susitna, North Slope, and Northwest Arctic Boroughs
California	Alameda, Contra Costa, Los Angeles, Marin, Monterey, Napa, Orange, San Diego, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, and Ventura Counties
Louisiana	Assumption, Calcasieu, Cameron, Iberia, Jefferson, Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Martin, St. Mary, St. Tammany, Tangipahoa, Terrebonne, and Vermilion Parishes
Mississippi	Hancock, Harrison, and Jackson Counties
Texas	Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Harris, Jackson, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Orange, Refugio, San Patricio, Victoria, and Willacy Counties

The funds allocated to each State are based on the proportion of qualified OCS revenues (QOCSR) offshore the individual State to total QOCSR from all States. The EPAct requires a minimum allocation of 1 percent to each State and provides that 35 percent of each State's allocation be shared by its CPS's. **Table 3-18** shows the allocation of CIAP funds by fiscal year to each of the six eligible States and 67 eligible CPS's.

A State, in cooperation with its CPS's, must submit to BOEMRE for approval a CIAP State Plan (Plan) that describes how it will spend its CIAP funds. A State or CPS shall use all amounts received under CIAP for one or more of the following purposes: (1) projects and activities for the conservation, protection, or restoration of coastal areas, including wetland; (2) mitigation of damage to fish, wildlife, or natural resources; (3) planning assistance and the administrative costs of complying with this section; (4) implementation of a federally approved marine, coastal, or comprehensive conservation management plan; and (5) mitigation of the impact of OCS activities through funding of onshore infrastructure projects and public service needs.

Once a Plan is approved, a State and its CPS's are eligible to submit grant applications for the projects described in its Plan. All six States have approved Plans. Currently, Alaska, California, Louisiana, and Mississippi have approved FY 2007-2010 Plans and are eligible to submit grant applications for their FY 2007-2010 allocated funds. Alabama has an approved FY 2007-2008 Plan and therefore may only submit grant applications for its FY 2007-2008 funds, while Texas has an approved FY 2007 Plan and may only submit grant applications for its FY 2007 funds. From total allocated funds, **Table 3-19** shows the dollar amount of CIAP funds applied for, awarded, under review, and remaining for each Gulf State and CPS.

In 2011, it was announced that FWS will take over administration of CIAP, effective October 1, 2011. The eligibility requirements for States, CPS's, and fundable projects are expected to remain largely the same after the transfer.

The Gulf Coast Ecosystem Restoration Task Force

The Gulf Coast Ecosystem Restoration Task Force was set up by an Executive Order signed by President Obama on October 5, 2010 (The White House, 2010). The Task Force stated the Federal Government's desire to address longstanding ecological decline and begin moving toward a more resilient Gulf Coast ecosystem, especially in the aftermath of the DWH event. The Executive Order expressed the Federal Government's commitment to help residents conserve and restore resilient and healthy GOM ecosystems that support and sustain the diverse economies, communities, and cultures of the region and the important national missions carried out in the GOM.

The specific goals of the Task Force are to support economic vitality, enhance human health and safety, protect infrastructure, enable communities to better withstand impact from storms and climate change, sustain safe seafood and clean water, provide recreational and cultural opportunities, protect and preserve sites that are of historical and cultural significance, and contribute to the overall resilience of coastal communities. To support and enable these goals, the Task Force's role is to coordinate intergovernmental responsibilities, planning, and exchange of information so as to better implement ecosystem restoration and to facilitate appropriate accountability and support throughout the restoration process. The Executive Order directed Federal efforts to be efficiently integrated with those of local stakeholders, and that particular focus should be toward innovative solutions for complex, large-scale restoration projects. The Executive Order seeks science-based and well-coordinated solutions that minimize duplication and ensure effective delivery of services.

The Executive Order explicitly identified the following Federal agencies and groups as participating in Task Force: (1) Department of Defense; (2) Department of Justice; (3) Department of the Interior; (4) Department of Agriculture; (5) Department of Commerce; (6) Department of Transportation; (7) Environmental Protection Agency; (8) Office of Management and Budget; (9) Council on Environmental Quality; (10) Office of Science and Technology Policy; (11) Domestic Policy Council; and (12) other executive departments, agencies, and offices as the President may, from time to time, designate. In addition to these designated Federal participants, representatives of the five Gulf Coast States may be appointed by the President upon recommendation of the Governors of each state. These representatives are to be elected officers of State governments (or their designated employees with authority to act on their behalf) acting in their official capacities. The Task Force may include representatives from affected tribes, who are elected officers of those tribes (or their designated employees with authority to act on their behalf) acting in their official capacities. The Task Force shall, in collaboration with affected tribes, determine an appropriate structure for tribal participation in matters within the scope of the Task Force's responsibilities. No State or tribal representatives have yet been identified for the Task Force.

The Task Force held its inaugural meeting on November 8, 2010, at the Pensacola Civic Center in Pensacola, Florida. Attendees were reported as numbering approximately 250. The meeting was chaired by Ms. Lisa Jackson, USEPA Administrator, for whom the Task Force serves. The agency representatives for the federally designated agencies and groups introduced themselves as did the staff director for the Task Force. Pre-meeting materials provided to participants who had responded to an open and widely distributed announcement and invitation were provided with the two orders of business that Ms. Jackson wished the first meeting to focus upon.

(1) How in the coming months can the Task Force best enable the widest possible participation in this process? How can the Task Force best connect to keep everyone informed and to ensure good two-way communication?

(2) Which of the many critical substantive issues about restoration should the Task Force focus on first? Which ones rise to the top for immediate attention knowing that all of them will be eventually have to be addressed?

Some of the insights gathered at the first Task Force meeting are as follows: (1) the Task Force wanted to receive as much bottoms-up input as they could so that they could formulate how they think the Task Force would operate; (2) there is no current budget for the Task Force and the staff conducting the work supported by their host agencies, and (3) the outputs are not yet defined. At this early point, the Task Force appears to view their role as coordination and information sharing for already approved or established planning efforts, such as coastal restoration projects administrated by COE and the State of Louisiana, or the CIAP administered by BOEMRE.

Ms. Jackson's closing remarks stated that Task Force members and staff were now obligated to answer the many questions elicited from the inputs requested by Ms. Jackson's two orders of business for the first meeting. Much useful input was received on Ms. Jackson's question, "How can the Task Force best connect to keep everyone informed and to ensure good two-way communication?" The inputs received on question 2, "What should the Task Force focus on first?" was very general and conceptual and did not seem to elicit as much useful information for the Task Force's next steps. The Task Force has a website (www.restorethegulf.com) to keep observers aware of its activities.

3.3.5. Natural Events or Processes

3.3.5.1 Hurricanes

Chapter 3.3.5.7.3 of the Multisale EIS and Chapter 3.1.1.5.3 of the 2009-2012 Supplemental EIS discuss damage to infrastructure from recent hurricanes. Climatic cycles in tropical latitudes typically last 20-30 years, or even longer (USDOC, NOAA, 2005). As a result, North Atlantic experiences alternating periods of above-normal or below-normal hurricane seasons. There is a two- to three-fold increase in hurricane activity during eras of above-normal activity. The hurricane activity from 1995 to 2007 is representative of an era of above-normal hurricane activity (Elsner et al., 2008, p. 1,210).

Seventeen hurricanes made landfall in the WPA or CPA during the 1995-2009 hurricane seasons, disrupting OCS oil and gas activity in the GOM (**Table 3-20**). Half of these hurricanes reached a maximum strength of Category 1 or 2 while in the CPA or WPA, while the other half were powerful hurricanes reaching maximum strengths of Categories 4 or 5. The current era of heightened Atlantic hurricane activity began in 1995; therefore, the GOM could expect to see a continuation of above-normal hurricane activity during the first 10-20 years of the 40-year analysis period and below-normal activity during the remaining 20-30 years of the 40-year analysis period.

Hurricanes Ivan, Katrina, Rita, Gustav, and Ike caused extensive damage to OCS platforms, topside facilities, and pipeline systems (**Table 3-21).** During Hurricanes Ivan, Katrina, and Rita, 9 jack-up rigs and 19 moored rigs were either toppled or torn from their mooring systems. Sixty platforms were destroyed as a result of Hurricanes Gustav and Ike in 2008.

After the 2005 hurricanes, this Agency set forth guidance to ensure compliance with 30 CFR 250.417 and to improve performance in the area of jack-up and moored rig station-keeping during the environmental loading that may be experienced during hurricanes. Industry, USCG, and this Agency worked together to develop interim recommended practices for the use of jack-up and moored rigs during the future hurricane seasons to potentially decrease the amount of failures during hurricanes. This Agency issued NTL 2006-G10, "Moored Drilling Rig Fitness Requirements for the 2006 Hurricane Season," and NTL 2006-G09, "Jack-up Drilling Rig Fitness Requirements for the 2006 Hurricane Season." These NTL's provide guidance on the information operators must submit with the application for permit to drill to demonstrate the fitness of any jack-up or moored drilling rig to conduct drilling, workover, or completion operations in the Gulf of Mexico OCS during the 2006 hurricane season, and beyond, that remain applicable until revised. These NTL's represent a small part of the response to review and provide guidance to operators for MODU requirements and reporting in light of the recent experiences from damage caused by recent hurricanes.

3.3.5.2. Currents as Transport Agents

Physical oceanographic processes in the GOM contributing to the distribution of spilled oil include the Loop Current, Loop Current eddies, and whirlpool-like features underneath the Loop Current and Loop Current eddies that interact with the bottom. Infrequently observed processes include a limited number of high-speed current events, at times approaching 100 cm/s (39 in/s). These events were observed at depths exceeding 1,500 m (4,921 ft) in the northern GOM (Hamilton and Lugo-Fernandez, 2001; Hamilton et al., 2003) and as very high-speed currents in the upper portions of the water column observed in deep water by several oil and gas operators. All of these processes are described in Appendix A.2 of the Multisale EIS. Generally, current speed in the deep GOM has been observed to decrease with depth. Mean deep flow around the edges of the GOM circulates in a counterclockwise direction at ~2,000 m (6,562 ft) (Sturges et al., 2004) and at ~900 m (2,953 ft) (Weatherly, 2004).

Mean seasonal circulation patterns of inner-shelf and outer-shelf currents on the Louisiana-Texas continental shelf, the northeastern GOM shelf, and the West Florida shelf are described in Appendix A.2 of the Multisale EIS. These currents are primarily wind driven and are also influenced by riverine outflow. Cold water from deeper off-shelf regions moves onto and off the continental shelf by cross-shelf flow associated with upwelling and downwelling processes in some locations (Collard and Lugo-Fernandez, 1999). Wind events such as tropical cyclones (especially hurricanes), extratropical cyclones, and cold-air outbreaks can result in extreme waves and cause currents with speeds of 100-150 cm/s (39-59 in/s) over continental shelves. Wave heights of 91 ft (28 m) were measured during the passage of Hurricane Ivan through the northern GOM (Wang et al., 2005).

The physical oceanography of the GOM, and the natural processes that may influence the cumulative activities scenario, was discussed in Chapter 3.3.7.1 of the 2009-2012 Supplemental EIS. Since that time, several new reports on circulation of the Gulf's deep waters have been completed. The main findings from such studies are as follows: (1) the deep Gulf can be approximated as a two-layer system with an upper layer about 800- to 1,000-m (2,625- to 3,281-ft) thick that is dominated by the Loop Current and associated clockwise whirlpools (Cox et al., in preparation; Welsh et al., 2009; Inoue et al., 2008); (2) the lower layer below ~1,000 m (3,281 ft) has near uniform currents (Cox et al., in preparation; Welsh et al., 2009; Inoue et al., 2008); (3) the coupling between these two layers is generally absent, but it seems that motions of the layer interface are needed to transmit the energy from the Loop Current and eddies downward (Cox et al., in preparation; Welsh et al., 2009; Inoue et al., 2008, Donohue et al., 2008); (4) there is a wealth of secondary whirlpools with smaller diameters (50-100 km; 31-62 mi) that affect the exchange between the shelf and deepwater, and these smaller whirlpools interact with the larger Loop eddies (Donohue et al., 2008); and (5) the ocean's response to tropical storms and hurricanes is similar to that reported previously, but a new mode was found to transport the hurricane's energy downward related to the sea-level rise near the storm eye (Welsh et al., 2009; Cole and DiMarco, 2010).

Caribbean Sea waters colliding with the Yucatan Peninsula turn northward and enter the Yucatan Channel as a strong flow called the Yucatan Current. This current exhibits two basic arrangements inside the GOM. First, the Yucatan Current enters the Gulf and turns immediately eastward, exiting the Gulf towards the Atlantic Ocean via the Florida Straits to become the Gulf Stream. The second arrangement consist of a northward penetration of the Yucatan Current into the Gulf reaching to 26º-28ºN latitudes, then curls clockwise turning south, and exiting via the Florida Straits into the Atlantic Ocean to become, again, the Gulf Stream. The stream inside the Gulf is called the Loop Current. The Loop Current transports warm and salty water year round into the GOM at a rate of 25-30 million cubic meters per second, and it is the main energy source for oceanographic processes inside the Gulf. At its climatic northern position, the Loop becomes unstable, breaks, and sheds a large (200- to 400-km diameter [124- to 248-mi diameter]) clockwise whirlpool that travels southwestwards at speeds of 4-8 km/day (2-5 mi/day). The southwest trip of Loop Current eddies continues until colliding with the Texas and Mexico continental slope in the western GOM, where they disintegrate. This sequence connects the eastern with the western Gulf, which otherwise appear disconnected.

CHAPTER 4

DESCRIPTION OF THE ENVIRONMENT AND IMPACT ANALYSIS

4. DESCRIPTION OF THE ENVIRONMENT AND IMPACT ANALYSIS

The impacts of 11 WPA and CPA sales were analyzed in the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222, Final Environmental Impact Statement* (Multisale EIS; USDOI, MMS, 2007b). An analysis of the routine, accidental, and cumulative impacts of a WPA or CPA proposed action on the environmental and socioeconomic resources of the Gulf of Mexico can be found in Chapters 4.2, 4.4, and 4.5 of the Multisale EIS, respectively. The Multisale EIS was supplemented by the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218; Final Supplemental Environmental Impact Statement* (2009-2012 Supplemental EIS; USDOI, MMS, 2008a) and included an analysis on the 181 South Area that was made available for leasing through the Gulf of Mexico Energy Security Act of 2006. An analysis of the routine, accidental, and cumulative impacts of a CPA or WPA proposed action on the environmental and socioeconomic resources of the Gulf of Mexico can be found in Chapter 4 of the 2009-2012 Supplemental EIS. The Multisale EIS and the 2009-2012 Supplemental EIS are hereby incorporated by reference.

The purpose of this Supplemental EIS is to determine if there are significant new circumstances or information bearing on the proposed action or its impacts, as stated in the Multisale EIS and the 2009-2012 Supplemental EIS, and, if so, to disclose those changes and conclusions. This includes all new information and not just that acquired since the DWH event. This includes all new information and not just that acquired since the DWH event. This Supplemental EIS was prepared in consideration of the potential changes to the baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of the DWH event. The environmental resources include sensitive coastal environments, offshore benthic resources, marine mammals, sea turtles, coastal and marine birds, endangered and threatened species, and fisheries. This Supplemental EIS also considered the DWH event in the analysis of the potential alternatives of the proposed action.

It must be understood that this Supplemental EIS analyzes the proposed action and alternatives for the proposed WPA lease sale. This is not an EIS on the DWH event, although information on this event is being analyzed as it applies to resources in the WPA.

4.1. PROPOSED WESTERN PLANNING AREA LEASE SALE 218

Proposed WPA Lease Sale 218 is scheduled to be held in late 2011 or early 2012. The WPA encompasses about 28.7 million ac, mostly located beyond 3 leagues (10 mi; 16 km) offshore Texas and extends seaward to the limits of the United States jurisdiction over the continental shelf in water depths up to approximately 3,346 meters (m) (10,978 ft) (**Figure 1-1**). The proposed action would offer for lease all unleased blocks in the WPA for oil and gas operations (**Figure 2-1**), with the following exceptions:

(1) whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary; and

(2) whole and partial blocks that lie within the former Western Gap portion of the 1.4-nmi buffer zone north of the continental shelf boundary between the U.S. and Mexico.

Chapter 4.1 presents baseline data for the physical, biological, and socioeconomic resources that would potentially be affected by the proposed action or the alternatives, and it presents analyses of the potential impacts of routine events, accidental events, and cumulative activities on these resources. Baseline data are considered in the assessment of impacts from proposed WPA Lease Sale 218 on these resources.

During the past few years, the Gulf Coast States and GOM oil and gas activities have been impacted by several major storms and hurricanes. Appendix A.3 of the Multisale EIS provides information on Hurricanes Lili (2002), Ivan (2004), Katrina (2005), and Rita (2005). In 2008, Hurricanes Gustav and Ike also impacted OCS infrastructure **(Chapter 3.3.7.2)**. The description of the affected environment below includes impacts from these storms on the physical, biological, and socioeconomic resources.

The DWH event off the Louisiana coast resulted in the largest oil spill in U.S. history. Approximately 4.9 million barrels flowed into the Gulf over a period of 87 days. An event such as this has the potential to adversely affect multiple resources over a large area. The level of adverse effect depends on many factors, including the sensitivity of the resource as well as the sensitivity of the environment in which the resource is located. All effects may not initially be seen and some could take years to fully develop. The analyses of impacts from the DWH event on the physical, biological, and socioeconomic resources below are based on post-DWH credible scientific information that was publicly available at the time the document was prepared, applied using accepted methodologies. However, the effects of proposed WPA Lease Sale 218 on these resources are expected to be substantially the same as those presented in the Multisale EIS. The conservative approach would be to expect that impacts from the lease sale may be greater than prior to the DWH event, although the magnitude of those impacts cannot yet be fully determined (**Chapter 4.1**, "Incomplete or Unavailable Information"). The BOEMRE will continue to monitor these resources for effects caused by the DWH event. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2)**. Data collected by the Operational Science Advisory Team (OSAT) indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010).

Chapter 4.1.3.4.4 of the Multisale EIS provides information on accidental spills that could result from all operations conducted under the OCS Program, as well as information on the number and sizes of spills from non-OCS sources. The number of spills ≥1,000 bbl and >10,000 bbl estimated to occur as a result of the WPA proposed action is provided in **Tables 3-5 and 3-7**. The mean number of spills > 10,000 bbl estimated for the WPA proposed action is <1 spill. Figure 4-11 of the Multisale EIS provides the probability of a particular number of offshore spills ≥1,000 bbl occurring from facility or pipeline operations in the WPA. Spill rates for all of the spill-size categories are provided in Table 4-16 of the Multisale EIS. The probabilities of a spill ≥1,000 bbl occurring and contacting modeled environmental resources are described in Chapter 4.3.1.5.7 and Figures 4-13 through 4-31 of the Multisale EIS.

The potential impacts of a low-probability spill, catastrophic oil spill such as the one that resulted from the DWH event, to the environmental and cultural resources and socioeconomic conditions analyzed in this Supplemental EIS are addressed in the "Catastrophic Spill Event Analysis" (**Appendix B**). The reader is referred to **Appendix B** for the analysis of potential effects of a catastrophic event for each resource.

The following cumulative analyses consider impacts to physical, biological, and socioeconomic resources that may result from the incremental impact of proposed WPA Lease Sale 218 when added to all past, present, and reasonably foreseeable future human activities, including non-OCS activities, as well as all OCS activities (OCS Program). Non-OCS activities include, but are not limited to, import tankering; State oil and gas activity; recreational, commercial and military vessel traffic; offshore LNG activity; recreational and commercial fishing; onshore development; and natural processes. The OCS Program scenario includes all activities that are projected to occur from past, proposed, and future lease sales during the 40-year analysis period (2007-2046). This includes projected activity from lease sales that have been held, but for which exploration or development has not yet begun or is continuing.

Analytical Approach

The analyses of potential effects to the wide variety of physical, environmental, and socioeconomic resources in the vast area of the GOM and adjacent coastal areas is very complex. Specialized education, experience, and technical knowledge are required, as well as familiarity with the numerous impact-producing factors associated with oil and gas activities and other activities that can cause cumulative impacts in the area. Knowledge and practical working experience of major environmental laws and regulations such as NEPA, the Clean Water Act, CAA, CZMA, ESA, MMPA, Fishery Conservation and Management Act, and others are also required.

In order to accomplish this task, BOEMRE has assembled a multidisciplinary staff with hundreds of years of experience. The vast majority of this staff has advanced degrees with a high level of knowledge related to the particular resources discussed in this chapter. This staff prepares the input to BOEMRE's lease sale EIS's and a variety of subsequent postlease NEPA reviews; they are also involved with ESA, EFH, and CZMA consultations. In addition, this same staff is also directly involved with the development of studies conducted by BOEMRE's Environmental Studies Program. The results of these studies feed directly into our NEPA analyses. To date, since 1973, approximately $251 million has been spent on physical, environmental, and socioeconomic studies in the Gulf of Mexico OCS Region. There are currently 96 ongoing studies in the Gulf of Mexico OCS Region, at a cost of about $46 million. A great deal of baseline knowledge about the GOM and the potential effects of oil and gas activities are the direct result of these studies. In addition to the studies staff, BOEMRE also has a Scientific Advisory Committee consisting of recognized experts in a wide variety of disciplines. The Scientific Advisory Committee has input to the development of the Environmental Studies Program on an ongoing basis.

For each lease sale EIS, a set of assumptions and a scenario are developed, and impact-producing factors that could occur from routine oil and gas activities, as well as accidental events, are described. This information is discussed in detail in **Chapter 3**. Using this information, the multidisciplinary staff described above applies their knowledge and experience to conduct their analyses of the potential effects of the proposed lease sale.

The conclusions developed by the subject-matter experts regarding the potential effects of the proposed lease sale for most resources are necessarily qualitative in nature; however, they are based on the expert opinion and judgment of highly trained subject-matter experts. This staff approaches this effort utilizing credible scientific information available since the Macondo spill and applied using accepted methodologies. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives, and if so, was either acquired or in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. This approach is described in the next subsection on "Incomplete or Unavailable Information."

Over the years, a suite of lease stipulations and mitigating measures have been developed to eliminate or ameliorate potential environmental effects, where implemented. In many instances, these were developed in coordination with other natural resource agencies such as NOAA and FWS. It must also be emphasized that, in arriving at the overall conclusions for certain environmental resources (e.g., coastal and marine birds, fisheries, and wetlands), the conclusions are not based on impacts to individuals, small groups of animals, or small areas of habitat but on impacts to the resources/populations as a whole.

The BOEMRE has made conscientious efforts to comply with the spirit and intent of NEPA in its analyses of potential environmental effects, and to use adaptive management to respond to new developments related to the OCS Program.

Incomplete or Unavailable Information

In the following analyses of physical, environmental, and socioeconomic resources, there are references to incomplete or unavailable information, particularly in relation to the DWH event and the associated oil spill. The subject-matter experts for each resource used what scientifically credible information was publicly available at the time this Supplemental EIS was written, and acquired, when possible, new information since the prior Multisale EIS and 2009-2012 Supplemental EIS. This new information is included in the description of the affected environment and impact analyses throughout **Chapter 4**. Where necessary, the subject-matter experts extrapolated from existing or new information, using accepted methodologies, to make reasoned estimates and developed conclusions regarding the current WPA baseline for resource categories and expected impacts from the proposed action given any baseline changes. Since this document supplements the Multisale EIS and 2009-2012 Supplemental EIS, the subject-matter experts were tasked with determining if the conclusions made in the Multisale EIS and 2009-2012 Supplemental EIS on the significance of impacts had changed based upon the new information.

The most notable information change since the prior Multisale EIS and 2009-2012 Supplemental EIS relates to the DWH event in the CPA. Credible scientific data regarding the potential short-term and long-term impacts on both CPA and WPA resources is incomplete, and it could be many years before this information becomes available via the Natural Resource Damage Assessment (NRDA) process, BOEMRE's Environmental Studies Program, and numerous studies by academia. Nonetheless, the subject-matter experts acquired and used new scientifically credible information that was available, determined that additional information was not available absent exorbitant expenditures or could not be obtained regardless of cost in a timely manner, and where gaps remained, exercised their best professional judgment to extrapolate baseline conditions and impact analyses using accepted methodologies based on credible information. Their overall conclusion was that resources in the WPA were not significantly affected or, in most cases, not affected at all by the DWH event.

It is important to note that, barring another catastrophic oil spill, which is a low-probability accidental event, the adverse impacts associated with the proposed WPA lease sale are small, even in light of the DWH event. This is because of BOEMRE's lease sale stipulations and mitigations, site-specific mitigations that become conditions of plan or permit approval at the postlease stage, and mitigations required by other State and Federal agencies. Lease sale stipulations include the Topographic Features Stipulation, Military Areas Stipulation, Law of the Sea Convention Royalty Payment Stipulation and Protected Species Stipulation. Site-specific postlease mitigations include buffer zones and avoidance criteria to protect sensitive resources such as areas of topographic relief, chemosynthetic communities, deepwater corals, and historic shipwrecks. Mitigations required by other agencies (i.e., the U.S. Army Corps of Engineers and State CZM agencies) to reduce or avoid impacts from OCS activities include boring under beach shorelines and rerouting of pipelines to reduce or eliminate impacts from OCS pipelines that make landfall.

The incomplete or unavailable information identified by the subject-matter experts were grouped into categories that were evaluated to determine whether that information was essential to a reasoned choice among alternatives:

- *Physical Resources in the WPA*: Physical resources (i.e., water quality and air quality) within the WPA were likely not affected to any discernable degree by the DWH event, based on the best available information and the WPA's distance from the Macondo well. At the time this Supplemental EIS was written, the available data showed that surface oil was present within a measurable radius around Mississippi Canyon Block 252. That radius never extended out to the distance of the WPA perimeter. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). Impacts from the DWH event to surface water in the WPA are therefore highly unlikely. The use of dispersants at the wellhead resulted in the creation of a subsea dispersed oil plume and/or diminished dissolved oxygen signature of impact of the oil. Had the water with the depressed dissolved oxygen signature traveled to the WPA, the minimal level of dissolved oxygen depression, combined with the likely ongoing mixing and possible reoxygenation and the fact that areas of depleted oxygen unrelated to the DWH event have been known to occur on the WPA shelf during the summer, when evaluated together, support the assumption that there would be no impact to surface or subsurface water quality in the WPA from the DWH event. During the spill, air data was collected by State agencies at the coastline at locations much closer to the DWH site than the WPA. The small number of samples where DWH contaminants were detected supports the conclusion that elevated air pollutants would have been diluted to background levels prior to reaching the WPA. Therefore, as identified in the resource analyses in this Supplemental EIS, incomplete or unavailable information regarding physical resources in the WPA may be relevant to reasonably foreseeable significant adverse effects. Unfortunately, much of this information related to the DWH event may not be available for some time, regardless of the costs necessary to obtain this information, as there are numerous task forces and interagency groups involved in the production of the information. It is not expected that this data would become publicly available in the near term, and certainly not within the timeframe contemplated by this NEPA analysis. In any event, BOEMRE has determined that the information is not essential to a reasoned choice among alternatives.

- *Nonmobile Biological Resources within the WPA*: Coastal and offshore biological and benthic habitats (i.e., barrier beaches, wetlands, seagrasses, soft-bottom habitats, topographic features, chemosynthetic communities, and nonchemosynthetic communities) and nonmobile benthic species that would be expected to spend their entire life cycle in the WPA were likely not affected to any discernable degree by the DWH event, based on the WPA's distance from the Macondo well and currently available data that the spill did not reach WPA waters or sediments. Similarly to the analysis of physical resources in the WPA described in the preceding paragraph, BOEMRE has determined that the incomplete or unavailable information regarding nonmobile resources is not essential to a reasoned choice among alternatives.
- *Mobile Biological Resources within or Migrating through the WPA*: Certain mobile biological resources (i.e., birds, fish, marine mammals, and sea turtles) having ranges and/or habitats that may include different areas in the Gulf of Mexico may have individually been affected by exposure to oil and/or spill-response activities, provided they were in the vicinity of the DWH event during spill conditions. For several species, scientifically credible information indicates that the biological resources likely to be present in the WPA are either unlikely to have been impacted by the DWH event or have not and are not experiencing chronic stress or persistent adverse effects at the population level. For example, several groups and species of birds in the WPA are unlikely to have been impacted by the DWH event, as their migration patterns indicate they would be unlikely to migrate laterally between the WPA and where the DWH spill occurred. Others, including an endangered bird species, were likely at their summer breeding grounds thousands of miles to the north at the time of the DWH event (**Chapter 4.1.1.12.1**). The extent of recovery of individual species that were potentially adversely affected by the spill and likely to be present in the WPA when exploration activities first occur as a result of this lease sale is uncertain and will depend on the severity, duration, and persistence of the original effect, as well as a given species' resiliency and residual sensitivity. For those individuals and subpopulations, consensus information is still emerging on the magnitudes of these impacts and the length of time for baseline conditions to return to pre-spill conditions.
  - For impacts from routine events: Although this information would be relevant to a discussion of reasonably foreseeable significant adverse impacts, much of this information may not be available for some time, regardless of the resources necessary to obtain this information, as there are numerous task forces and interagency groups involved in the production of the information. It is not expected that this data would become publicly available in the near term, and certainly not within the timeframe contemplated by this NEPA analysis. Regardless, BOEMRE has concluded that this incomplete or unavailable information is not essential to a reasoned choice among the alternatives since the adverse impacts from routine activities associated with the WPA proposed action are small, even in light of how baseline conditions may have been changed by the DWH event. It is not essential to a reasoned choice among the alternatives because the subject-matter experts for this Supplemental EIS have already evaluated the probability and severity of these potential impacts and it is not essential to understand every particular mechanism by which these significant impacts could occur.
  - For impacts from accidental or catastrophic events: This Supplemental EIS acknowledges that very large oil spills could result in significant adverse impacts regardless of the alternative. Impacts from accidental or catastrophic events would result in significant adverse impacts for each of the alternatives. Although relevant and available information on how the DWH event may

inform an analysis of impacts of a catastrophic spill is provided in this Supplemental EIS, additional information may not be available for some time, regardless of the costs necessary to obtain this information, as there are numerous task forces and interagency groups involved in the production of the information. It is not expected that this data would become publicly available during the pendency of this NEPA analysis. However, any incomplete or unavailable information regarding the nature of a very large spill would not be essential to a reasoned choice among the alternatives since the impacts of accidental or catastrophic events would be similar under any of the alternatives. A catastrophic spill and its impacts are not "expected" as a result of the lease sale since it remains a low-probability event, particularly in light of improved safety and oil-spill-response requirements that have been put in place since the spill.

- *Endangered and Threatened Species*: The BOEMRE reinitiated consultation with NMFS and FWS in light of new information that may become available on these species and in light of effects from the DWH event. Pending the completion of the reinitiated ESA Section 7 Consultation, BOEMRE has prepared an ESA Section 7(d) determination (see 50 CFR 402.09). Section 7(d) of the ESA requires that, after initiation (or reinitiation in this case) of consultation under Section 7(a)(2), the Federal agency "shall not make any irreversible or irretrievable commitment of resources with respect to the agency action which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures which would not violate" Section 7(a)(2). The BOEMRE has determined that the proposed action during the reinitiated Section 7 consultation is consistent with the requirements of ESA Section 7(d) because (1) approving and/or conducting these activities will not foreclose the formulation or implementation of any Reasonable and Prudent Alternative measures that may be necessary to avoid jeopardy (or the likely destruction or adverse modification of critical habitat) and (2) the Secretary of the Interior retains the discretion under OCSLA to deny, suspend, or rescind these plans and permits at any time, as necessary to avoid jeopardy. Further, BOEMRE has determined that the existing completed Section 7 consultation still applies to the remaining lease sales from the *Five-Year Outer Continental Shelf Oil and Gas Leasing Program (2007-2012)* in the CPA and WPA of the Gulf of Mexico as lease sales alone do not constitute an irreversible and irretrievable commitment of resources. In addition, the results of consultation and any additional relevant information on these species can be employed during postlease activities to ensure that Reasonable and Prudent Alternative measures are not foreclosed.

- *Natural Resource Damage Assessment (NRDA) Data*: In response to the DWH event, a major Natural Resource Damage Assessment is underway to assess impacts to all natural resources in the Gulf of Mexico that may have been impacted by the resulting spill from the Macondo well, as well as impacts from the spill-response operations. The NRDA is mandated by the Oil Pollution Act of 1990 (OPA). The U.S. Department of Interior is a cooperating agency in the NRDA process and BOEMRE is a cooperating agency on a Programmatic EIS being prepared as part of the NEPA analysis for NRDA. However, the NRDA process is being led by the NRDA Trustees, which include NOAA and DOI (FWS and NPS), but not BOEMRE. The BOEMRE is not a Trustee, but an "affected party." At this time, limited data compiled in the NRDA process has been made publicly available. Because limited data has been made publicly available, most NRDA datasets are not available for BOEMRE to use in its NEPA analyses. The BOEMRE acknowledges that the ability to obtain and use the NRDA data in its NEPA analysis could be relevant to reasonably foreseeable significant adverse impacts; however, the NRDA data are not essential to a reasoned choice among the alternatives. Impacts identified through the NRDA process would likely be the same under any alternative and obtaining this data would not help inform the decisionmaker on a choice among those alternatives. This is because, as discussed above, the adverse impacts associated with the proposed WPA lease sale are small, even in light of how baseline conditions in the WPA may have been changed by the DWH event. The reason the impacts are small is because of BOEMRE's lease sale stipulations and mitigations, site-specific mitigations that become conditions of plan or permit approval at the postlease stage, and mitigations required by other State and Federal agencies. Even if the NRDA data were essential to a reasoned choice among the alternatives, it is not publicly available and much of the data may not become available for many years. The NEPA allows for decisions to be made based on available scientifically credible information applied using accepted methodologies where the incomplete information cannot be obtained or the cost of obtaining is exorbitant. The NRDA process is ongoing and there is no timeline on when this information will be released. It is not within BOEMRE's authority to obtain this information. Cost is not an issue in obtaining the information, regardless of whether the cost would be exorbitant or not. The limitations on the NRDA process, including statutory requirements under OPA, are the determining factor on the availability of this information, not the cost of obtaining it. In light of the fact that the NRDA data may not be available for years, BOEMRE has used accepted scientific methodologies to evaluate each resource, as described in this chapter. Since the spill, the Gulf of Mexico Region's Environmental Studies Program has continually modified its Studies Plan to reflect this Agency's current information needs for studies that address impacts and recovery from the oil spill. The BOEMRE's proposed studies attempt to avoid duplication of study efforts yet fill information gaps where NRDA studies may not address particular resources and their impacts from the oil spill. It is unreasonable to delay actions based on information that will not be available for an inordinate length of time, or perhaps will never become available at all.

- *Socioeconomic and Cultural Resources*: Incomplete or unavailable information related to socioeconomic and cultural impacts (i.e., commercial and recreational fishing, recreational resources, archaeological resources, land use and coastal infrastructure, demographics, economic factors, and environmental justice) may be relevant to reasonably foreseeable adverse impacts on these resources. With regard to DWH, in most instances, BOEMRE has determined that the incomplete or unavailable information would not be essential to a reasoned choice among alternatives. For example, for economic and demographic impacts, the maximum population that could be reasonably foreseen to be impacted by any of the alternatives identified in this Supplemental EIS is estimated at less than 1 percent of the population in the economic impact area analyzed in the Supplemental EIS. Therefore, even in light of any change in baseline because of the DWH event, the impact of the proposed action or alternatives would still be exceedingly small. The one instance where BOEMRE identified incomplete or unavailable information (in the Environmental Justice analysis in **Chapter 4.1.1.18.4**) that may be essential to a reasoned choice among alternatives could be related to information on health effects related to a catastrophic spill, despite the fact that current data indicate that onshore environmental quality data after the DWH event was well within health-based standards. Regardless of the costs associated with obtaining it, this information would be difficult to obtain because of the long period (e.g., decades) needed to perform reliable epidemiological studies and the inability to determine the causative agent among a variety of environmental factors, among other issues. In its place, the subject-matter expert applied what credible scientific information that was available using accepted methodologies, and BOEMRE takes a conservative approach in the analysis and acknowledges that a catastrophic spill could result in significant impacts.

This chapter has thoroughly examined the existing credible scientific evidence that is relevant to evaluating the reasonably foreseeable significant adverse impacts of the proposed WPA lease sale on the human environment. The subject-matter experts that prepared this Supplemental EIS conducted a diligent search for pertinent information, and BOEMRE's evaluation of such impacts is based upon theoretical approaches or research methods generally accepted in the scientific community. All reasonably foreseeable impacts were considered, including impacts that could have catastrophic consequences, even if their probability of occurrence is low. As identified above, where information was incomplete or unavailable, BOEMRE complied with its obligations under NEPA to determine if the information was relevant to reasonably foreseeable significant adverse impacts; if so, whether it was essential to a reasoned choice among alternatives; and, if it is essential, whether it can be obtained and whether the cost of obtaining the information is exorbitant, or whether generally accepted scientific methodologies can be applied in its place (see 40 CFR 1502.22). In those cases where incomplete or unavailable information was not essential to a reasoned choice among alternatives, BOEMRE nonetheless determined where additional information was not available absent exorbitant expenditures or could not be obtained regardless of cost in a timely manner, and when gaps existed, exercised their best professional judgment to extrapolate baseline conditions and impact analyses using accepted methodologies based on credible information. Based on the above and the discussions in the individual resources analyses, the impact conclusions presented in this Supplemental EIS are substantially the same as those presented in the Multisale EIS and the 2009-2012 Supplemental EIS from which this Supplemental EIS is tiered.

4.1.1. Alternative A—The Proposed Action

4.1.1.1. Air Quality

The BOEMRE has reexamined the analysis for air quality presented in the Multisale EIS and the 2009-2012 Supplemental EIS based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusion for air quality presented in the Multisale EIS and the 2009-2012 Supplemental EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS. A summary of those analyses and their reexamination due to new information is presented in the following sections. A brief summary of potential impacts follows. Emissions of pollutants into the atmosphere from the routine activities associated with the WPA proposed action are projected to have minimal impacts to onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline, and the emissions are expected to be well within the National Ambient Air Quality Standards (NAAQS). While regulations are in place to reduce the risk of impacts from H_2S and while no H_2S-related deaths have occurred on the OCS, accidents involving high concentrations of H_2S could result in deaths as well as environmental damage. These emissions from routine activities and accidental events associated with the proposed action are not expected to have concentrations that would change onshore air quality classifications. The total impact from all onshore and offshore emissions (such as roads, power generation, and industrial activities) would continue to significantly affect the ozone nonattainment areas in southeast Texas and the parishes near Baton Rouge, Louisiana. The proposed action would make an insignificant contribution to ozone levels in the nonattainment areas and would not interfere with the States' schedules for compliance with the NAAQS.

4.1.1.1.1. Description of the Affected Environment

A detailed description of air quality in the Gulf of Mexico can be found in Chapter 3.1.1 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.1.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The Clean Air Act (CAA) established the NAAQS. The primary standards are set to protect public health, and the secondary standards are set to protect public welfare, such as visibility or to protect vegetation. The current NAAQS address six pollutants: carbon monoxide, lead, nitrogen dioxide (NO_2), particulate matter (PM), ozone (O_3) and sulfur dioxide (SO_2) (**Table 4-1**). Particulate material is presented as two categories according to size. Coarse particulate matter is between 2.5 μm and 10 μm (PM_{10}), and fine particulate matter is less than 2.5 μm in size ($PM_{2.5}$). Under the CAA, USEPA is periodically required to review and, as appropriate, modify the criteria based on the latest scientific knowledge. Several revisions to the NAAQS have occurred since the publication of the Multisale EIS as more is understood about the effects of the pollutants.

Effective December 17, 2006, USEPA revoked the annual PM_{10} standard and revised the 24-hour $PM_{2.5}$ from 65 $\mu g/m^3$ to 35 $\mu g/m^3$. In early 2008, USEPA promulgated a new, more restrictive NAAQS 8-hour O_3 standard of 0.075 parts per million (ppm), which has been fully implemented. An additional revision to the 2008 revision of the 8-hour O_3 standard was proposed in January 2010. A value within the range of 0.060 to 0.070 ppm was recommended. As of November 2010, a final O_3 standard has not been issued. With the introduction of a new lower standard, additional Gulf Coast counties/parishes that are presently in attainment may become in nonattainment for ozone. Such an occurrence would likely generate renewed interest in OCS sources to mitigate the OCS contribution to ozone nonattainment. In turn, this would likely require BOEMRE to conduct additional air quality studies to more accurately determine the OCS contribution.

The USEPA also issued revisions to other NAAQS standards during 2010. Effective April 23, 2010, USEPA revised the NO_2 NAAQS standard to a new 1-hour standard of 100 parts per billion (ppb) (0.100 ppm). Effective August 23, 2010, USEPA revised the SO_2 NAAQS standard to a 1-hour standard of 75 ppb (0.075 ppm) and revoked the 24-hour and the annual SO_2 standards.

In response to the recent DWH event, USEPA and the affected States conducted extensive air quality monitoring along the Gulf Coast. The air monitoring conducted to date has found that the levels of ozone and particulates were at levels well below those that would cause short-term health problems (USEPA, 2010a). The air monitoring also did not find any pollutants at levels expected to cause long-term harm.

Attainment

Air quality depends on multiple variables—the location and quantity of emissions, dispersion rates, distances from receptors, and local meteorology. Meteorological conditions and topography may confine, disperse, or distribute air pollutants in a variety of ways.

The Clean Air Act Amendments of 1990 (CAAA) established classification designations based on regional monitored levels of ambient air quality. These designations impose mandated timetables and other requirements necessary for attaining and maintaining healthful air quality in the U.S. based on the seriousness of the regional air quality problem.

When measured concentrations of regulated pollutants exceed standards established by the NAAQS, an area may be designated as a nonattainment area for a regulated pollutant. The number of exceedances and the concentrations determine the nonattainment classification of an area. In the CAAA there are five classifications of nonattainment status—marginal, moderate, serious, severe, and extreme.

The Federal OCS waters' attainment status is unclassified. The OCS areas are not classified because there is no regulatory provision for any classification in the CAA for waters outside of the boundaries of State waters. Only areas within State boundaries are to be classified as either attainment, nonattainment, or unclassifiable.

Figure 4-1 presents the air quality status in the Gulf Coast as of January 2010. All air-quality nonattainment areas reported in **Figure 4-1** are for ozone nonattainment. As of May 27, 2008 (effective day), the new 8-hour ozone standard NAAQS of 0.075 ppm has been fully implemented. As of January 22, 2010, the new 1-hour nitrogen dioxide standard of 100 ppb has been fully implemented.

The attainment status for criteria pollutants (CO, SO_2, NO_2, PM, and O_3) for the Gulf Coast States adjacent to the WPA is stated below.

Texas is in attainment for the pollutants SO_2 and NO_2. The following Texas inland and coastal counties are classified as nonattainment for ozone: Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties in the Dallas/Fort Worth area; and Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties in the Houston/Galveston/Brazoria area (USEPA, 2011a). Louisiana is in attainment for CO, SO_2, NO_2, and PM. The O_3 nonattainment parishes in Louisiana are in the Baton Rouge area and include Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge Parishes (USEPA, 2011a). More recent monitoring data collected in the period 2006-2009 indicated that the Baton Rouge nonattainment area has not had any violations of the 8-hour ozone standards. The State is in the process of submitting the needed information so that USEPA can redesignate the area to attainment (*Federal Register*, 2010e). A steady decline in ozone concentration over the last two decades is a result of deliberate actions to reduce ozone precursor emissions, as well as research and regulatory work done to understand the causes of ozone formation in the area (Louisiana Dept. of Environmental Quality, 2004).

Jurisdiction

The responsibilities of BOEMRE are described in the OCSLA (43 U.S.C. 1334(a)(8)), which requires the Secretary of the Interior to promulgate and administer regulations that comply with the NAAQS pursuant to the Clean Air Act (42 U.S.C. 7401 et seq.) and to the extent that authorized activities significantly affect the air quality of any State. In 1990, pursuant to Section 328 of the CAAA and following consultation with the Commandant of the USCG and the Secretary of the Department of the Interior, the OCS waters east of 87.5° W. longitude were transferred to within the jurisdiction of USEPA. Operations west of 87.5° W. longitude in the GOM remain under BOEMRE jurisdiction for enforcement of the NAAQS.

The USEPA promulgated OCS air quality regulations at 40 CFR 55 to implement the statutory objectives. Over the past several years, BOEMRE has leased some blocks that are east of 87.5° W. longitude. These lessees are working with USEPA to obtain permits for air emissions (USEPA, 2010b).

Emission Inventories

The CAAA requires BOEMRE to coordinate air-pollution control activities with USEPA. Thus, there will be a continuing need for emission inventories and modeling in the future. The following is a summary of new information available since publication of the Multisale EIS and the 2009-2012 Supplemental EIS.

The BOEMRE has completed three air emissions inventory studies for calendar years 2000 (Wilson et al., 2004), 2005 (Wilson et al., 2007), and 2008 (Wilson et al., in press). These studies estimated emissions for all OCS oil and gas production-related sources in the Gulf of Mexico, including nonplatform sources, as well as other non-OCS-related emissions. The inventories included carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), particulate matter-10 (PM_{10}), $PM_{2.5}$, and volatile organic compounds (VOC's), as well as greenhouse gases—carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The widespread damage in the Gulf of Mexico caused by Hurricanes Katrina and Rita impacted the inventory results for September through December 2005. Due to the impacts of the hurricanes on OCS facilities in 2005, an updated Gulfwide emissions inventory study was funded for calendar year 2008, and more inventory data have been collected. The 2008 study was completed in December 2010 (Wilson et al., in press). In the summer of 2010, BOEMRE funded another cycle of this air emissions inventory to be conducted during 2011. These emissions inventories will be used in air quality modeling to determine the potential impacts of offshore sources to onshore areas.

Greenhouse Gas Reporting

In response to the FY 2008 Consolidated Appropriations Act, USEPA issued 40 CFR 98, which requires reporting of greenhouse gas emissions. On November 8, 2010, Subpart W of the Greenhouse Gas Reporting Rule was finalized. Subpart W requires petroleum and natural gas facilities that emit 25,000 metric tons or more of CO_2 equivalents per year to report emissions from equipment leaks and venting. The USEPA has determined that the activity data (Gulfwide Offshore Activities Data System [GOADS]) that has been collected to fulfill BOEMRE's emissions inventory may be used to comply with Subpart W of the Greenhouse Gas Reporting Rule. Subpart C of the Greenhouse Gas Reporting Rule requires operators to report greenhouse gas emissions from general stationary fuel combustion sources to USEPA. At this time, this Agency's GOAD's activity data may not be used to comply with Subpart C; therefore, affected operators will have to perform some additional efforts in order to comply (USEPA, 2010c).

General Conformity Regulations

New General Conformity Regulations were promulgated on March 24, 2010 (USEPA, 2011b). Federal agencies may negotiate with the States' emission budgets for future expansion or modification projects; one precursor pollutant emissions being offset through a reduction in emissions of another precursor (e.g., NO_x and VOC emissions); more flexibility regarding offsets for temporary emissions (where reductions in long-term emissions can be used); emission offsets being obtained from an adjacent nonattainment area, provided it results in an air quality benefit in the area of impact; and the establishment of a list of projects presumed to conform.

4.1.1.1.2. Impacts of Routine Events

Background/Introduction

A detailed description of the impacts of routine events on air quality in the Gulf of Mexico can be found in Chapter 4.2.1.1.1 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.1.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The following routine activities associated with the WPA proposed action would potentially affect air quality: platform construction and emplacement; platform operations; drilling activities; flaring; seismic-survey and support-vessel operations; pipeline laying and burial operations; evaporation of volatile petroleum hydrocarbons during transfers; and fugitive emissions. Supporting materials and discussions are presented in Chapter 3.1.1 and Appendix A.3 of the Multisale EIS and in **Chapters 4.1.1.1 and 3.1.1.5.1** of this Supplemental EIS. The impact analysis is based on four parameters—emission rates, surface winds, atmospheric stability, and the mixing height.

Emissions of certain air pollutants are known to be detrimental to public health and welfare. Some of these pollutants are directly emitted into the air, while others are formed in the atmosphere through chemical reactions. Nitric oxide and nitrogen dioxide constitute nitrogen oxides (NO_x) emissions. Nitrogen oxides, a by-product of all combustion processes, are emitted from sources such as internal combustion engines, natural gas burners, and flares. Nitrogen dioxide is a precursor pollutant involved in photochemical reactions that yield ozone. Nitrogen dioxide is an irritating gas that may increase susceptibility to infection and may constrict the airways of people with respiratory problems. Further, nitrogen dioxide can react with water to form nitric acid, which is harmful to vegetation, animals, and materials, as a result of increased acidity in precipitation (i.e., acid rain).

Carbon monoxide (CO) is a by-product of incomplete combustion, primarily contained in engine exhaust. Carbon monoxide is readily absorbed into the body through the lungs, where it reacts with hemoglobin in the blood, reducing the transfer of oxygen within the body. Carbon monoxide particularly affects people with cardiovascular and chronic lung diseases.

Sulfur dioxide (SO_2) may cause constriction of the airways and particularly affects individuals with respiratory diseases. Sulfur dioxide reacts in the atmosphere, principally with water vapor and oxygen, producing sulfuric acid, which along with nitric acid are the major constituents of acid rain. Acid rain can be harmful to animals, vegetation, and materials. The flaring of natural gas containing hydrogen sulfide (H_2S) and the burning of liquid hydrocarbons containing sulfur (Chapter 4.1.1.9 of the Multisale EIS) results in the formation of SO_2. The amount of SO_2 produced is directly proportional to the sulfur content of the hydrocarbons being flared or burned.

The concentration of the H_2S varies substantially from formation to formation and even varies to some degree within the same reservoir. The natural gas in deepwater reservoirs has been mainly sweet (i.e., low in sulfur content), but the oil averages between 1 and 4 percent sulfur content by weight. By far, most of the documented production of sour gas (i.e., high sulfur content) lies within 150 km (93 mi) of the Breton Wilderness Area.

Flaring of gas containing H_2S (sour gas) is of concern because it could significantly impact nearby onshore areas, particularly when considering the short-duration averaging periods (1 and 24 hr) for SO_2. The combustion of liquid hydrocarbon fuel is the primary source of sulfur oxides (SO_x), when considering the annual averaging period; however, impacts from high-rate well cleanup operations can generate significant SO_2 emissions. To prevent inadvertently exceeding established criteria for SO_2 for the 1-hour and 24-hour averaging periods, all incinerating events involving H_2S or liquid hydrocarbons containing sulfur are reported to BOEMRE and are evaluated individually for compliance with safety and flaring requirements.

The VOC's are precursor pollutants involved in a complex photochemical reaction with NO_x in the atmosphere to produce ozone. The primary sources of VOC's result from venting and evaporative losses that occur during the processing and transporting of natural gas and petroleum products. A more concentrated source of VOC's is the vents on glycol dehydrator units.

Particulate matter, also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. The size of particles is directly linked to their potential for causing health problems. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. The USEPA groups particle pollution into two categories. "Coarse particles," such as those found near roadways and dusty industries, range in size from 2.5 to 10 μm in diameter. The PM_{10} (particulate matter of 10 μm) can also affect visibility, primarily because of the scattering of light by the particles and, to a lesser extent, light absorption by the particles. This analysis considers mainly total suspended particulate (PM_{10}) matter. "Fine particles," such as those found in smoke and haze, have diameters smaller than 2.5 μm. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries, and automobiles react in the air. In general, particles with a diameter of 2.5 μm or smaller are more harmful to people because they pass through the throat and nose and enter the lungs (USEPA, 2010d).

Ozone is a nearly colorless gas with a faint but distinctive odor, somewhat similar to chlorine. It is formed in the troposphere (i.e., lower level of the atmosphere) from complex chemical reactions involving VOC's and NO_x in the presence of sunlight. At ground level, ozone can cause or aggravate respiratory problems, interfere with photosynthesis, damage vegetation, and crack rubber. Children, the elderly, and healthy people who work or exercise strenuously outdoors are particularly sensitive to elevated ozone concentrations.

Emissions of air pollutants would occur during exploration, development, and production activities. The profile of typical emissions for exploratory and development drilling activities shows that emissions of NO_x are the most prevalent pollutant of concern. Emissions during exploration are higher than emissions during development due to power requirements for drilling a deeper hole.

Platform emission rates for the GOM region were obtained from the 2008 emission inventory of OCS sources (Wilson et al., in press). This compilation was based on information from a survey of 3,304 platforms from 103 companies, Since these responses included all the major oil and gas production facilities, they were deemed representative of the type of emissions to be associated with a platform. The NO_x and VOC's are the primary pollutants of concern since both are considered to be precursors to ozone. Emission factors for other activities such as support vessels, helicopters, tankers, and loading and transit operations were taken from the OCS emission inventory (Wilson et al., in press).

Flaring is the burning of natural gas from a specially designed boom. Flaring systems are also used to vent gas during well testing or during repair/installation of production equipment. The BOEMRE operating regulations provide for some limited volume, short duration flaring or venting of some natural gas volumes upon approval by BOEMRE. These operations may occur for short periods of time (typically 2-14 days) as part of unloading/testing operations that are necessary to remove potentially damaging completion fluids from the wellbore, to provide sufficient reservoir data for the operator to evaluate a reservoir and development options, and in emergency situations. The potential impacts from these accidental events are discussed in **Chapter 4.1.1.1.3**.

Once pollutants are released into the atmosphere, atmospheric transport and dispersion processes begin circulating the emissions. Transport processes are carried out by the prevailing wind circulation. During summer, the wind regime in the WPA is predominantly onshore during daytime hours at mean speeds of 6.7-11.2 mph. Average winter winds are predominantly offshore at speeds of 8.9-17.9 mph (Appendix A.3 of the Multisale EIS). Although, for the summer months, the wind regime in the WPA is predominantly onshore during the day, OCS activities would not be expected to impact air pollutant levels in Texas because any pollutants emitted would be dispersed and recirculated prior to reaching shore. The majority of OCS Program-related emissions occur offshore anywhere from the State/Federal waters boundary to 200 mi (322 km) offshore, which limits the potential for emissions to result in impacts onshore.

Dispersion depends on emission height, atmospheric stability, mixing height, exhaust gas temperature and velocity, and wind speed. For emissions within the atmospheric boundary layer, the vertical heat flux, which includes effects from wind speed and atmospheric stability (via air-sea temperature differences), is a good indicator of turbulence available for dispersion (Lyons and Scott, 1990). Heat flux calculations in the WPA (Florida A&M University, 1988) indicate an upward flux year-round, being highest during winter and lowest in summer.

The mixing height is very important because it determines the vertical space available for spreading the pollutants. The mixing height is the height above the surface through which vigorous vertical mixing occurs. Vertical mixing is most vigorous during unstable conditions and is suppressed during stable conditions, resulting in the worst periods of air quality. Although mixing height information throughout the GOM is scarce, measurements near Panama City, Florida (Hsu, 1979), show that the mixing height can vary between 400 and 1,300 m (1,312 and 4,265 ft), with a mean of 900 m (2,953 ft). Generally, the mixing height tends to be higher in the afternoon, more so over land than over water. Further, the mixing height tends to be lower in winter, with daily changes smaller than in summer.

Proposed Action Analysis

The OCS emissions in tons per year for the criteria pollutants as a result of the proposed action are indicated in Table 4-17 of the Multisale EIS. The major pollutant emitted is NO_x, while PM_{10} is the least emitted pollutant. Combustion-intensive operations such as platform operations, well drilling, and service-vessel activities contribute mostly NO_x; platform operations are also the major contributors of VOC emissions. Platform construction emissions contribute appreciable amounts of all pollutants over the life of the proposed action. These emissions are temporary in nature and generally occur for a period of 3-4 months. Typical construction emissions result from the derrick barge placing the jacket and various modular components and from various service vessels supporting this operation. The drilling operations contribute considerable amounts of all pollutants. These emissions are temporary in nature and typically occur over a 40-day drilling period. Support activities for OCS activities include crew and supply boats, helicopters, and pipeline vessels; emissions from these sources consist mainly of NO_x and CO. These emissions are directly proportional to the number and type of OCS operations requiring support activities. Most emissions from these support activities occur during transit between the port and the offshore facilities; a smaller percentage of the emissions occur during idling at the platform. Platform and well emissions were calculated using the integration of projected well and platform activities over time.

The total pollutant emissions per year are not uniform. At the beginning of the proposed activities, emissions would be the largest. Emissions peak early on, as development and drilling start relatively quickly, followed by production. After reaching a maximum, emissions would decrease as wells are depleted and abandoned, platforms are removed, and service-vessel trips and other related activities are no longer needed.

The BOEMRE regulations (30 CFR 250.303) establish 1-hour and 8-hour significance levels for CO. A comparison of the projected emission rate to the BOEMRE exemption level would be used to assess CO impacts. The formula to compute the emission rate in tons/yr for CO is $3{,}400 \bullet D^{2/3}$; D represents distance in statute miles from the shoreline to the source. This formula is applied to each facility.

The VOC emissions are best addressed as their corresponding ozone impacts, which were studied in the Gulf of Mexico Air Quality Study (GMAQS) (Systems Applications International et al., 1995). The GMAQS indicated that OCS activities have little impact on ozone exceedance episodes in coastal nonattainment areas, including the Houston/Galveston, Port Arthur/Lake Charles, and Baton Rouge areas. Total OCS contributions to the exceedance (greater than 120 ppb) episodes studied were less than 2 ppb. In the GMAQS, the model was also run using double emissions from OCS petroleum development activities and the resulting attributable ozone concentrations, during modeling exceedance episodes, were still small, ranging 2-4 ppb. The activities under the proposed action would not result in a doubling of the emissions, and because the proposed activities are substantially smaller than this worst-case scenario, it is logical to conclude that their impact would be substantially smaller and not interfere with the States' scheduled compliance with the NAAQS (Systems Applications International et al., 1995). Additionally, 30 CFR 250.303(g)(2) requires that, if a facility would significantly impact (defined as exceeding the BOEMRE significance levels) an onshore nonattainment area, then it would have to reduce its impact fully through the application of the best available control technology and possibly through offsets as well. The new 8-hour ozone standard (0.075 ppm) has been fully implemented as of May 27, 2008. It is more stringent than the previous 1-hour standard, as well as the old 8-hour standard. In response to the1997 ozone standard (this was true when the new standard was 0.08 ppm), updated ozone modeling was performed using a preliminary Gulfwide emissions inventory for the year 2000 to examine the O_3 impacts with respect to the new 8-hour ozone standard. Two modeling studies were conducted. One modeling study focused on the coastal areas of Louisiana extending eastward to Florida (Haney et al., 2004). This study showed that the impacts of OCS emissions on onshore O_3 levels were very small, with the maximum contribution of 1 ppb or less to locations where the standard was exceeded. The other modeling effort dealt with O_3 levels in southeast Texas (Yarwood et al., 2004). The results of this study indicated a maximum contribution of 0.2 ppb or less to areas exceeding the standard.

Current industry practice is to transport OCS-produced oil and gas via pipeline whenever feasible. It is estimated that over 99 percent of the gas and oil produced pursuant to the proposed action would be piped to shore terminals. Thus, fugitive emissions associated with tanker and barge loadings and transfer would be small, as would the associated exhaust emissions. Safeguards to ensure minimum emissions from any offloading and loading operations of OCS crude oil production from surface vessels at ports have been adopted through administrative code by the States of Louisiana and Texas..

The BOEMRE studied the impacts of offshore emissions using the Offshore and Coastal Dispersion (OCD) Model. Three large areas in the WPA were modeled. The limiting factor on the size of each area was the run time needed to process the number of sources. The areas modeled were offshore Corpus Christi Bay, Matagorda Bay, and Galveston Bay. The receptors were set along the coastline and also a short distance inland in order to capture coastal fumigation. Circular areas were chosen to reduce edge effect. The areas were selected to best capture most of the offshore sources and to focus on the highly concentrated areas of development. Emissions for the proposed action were projected and compared with the emission inventory for the 2008 emission inventory. This inventory was then used as the database for the sources for the OCD modeling. Only the onshore maximum concentrations reported for all of the runs are discussed. The results of the runs are reported in Tables 4-18 and 4-19 of the Multisale EIS. The results are also compared with the federally allowable increases in ambient concentrations as regulated by 30 CFR 250.303(f) and 40 CFR 52.21.

Table 4-19 of the Multisale EIS lists the highest predicted contributions to onshore pollutant concentrations from OCS activities, as well as the maximum allowable increases over a baseline concentration established under the air quality regulations. While Table 4-19 of the Multisale EIS shows that OCS activities would result in concentration increases that are well within the maximum allowable limits for a PSD Class II area, a direct comparison between the two sets of figures is not possible. This is because the actual maximum allowable increase depends on the net change in emissions from all other sources in the area, both offshore and onshore, since the date the baseline level was established. Sources that were already in place at the applicable baseline date are included in the establishment of the baseline and corresponding concentration and do not count in the determination of the maximum allowable increment. The PM_{10} are emitted at a substantially smaller rate than NO_2 and SO_2; hence, impacts from PM_{10} would be expected to be even smaller since chemical decay was not employed in this dispersion modeling. The WPA proposed action would represent a small portion of the total OCS activity in the WPA; therefore, emissions from activities resulting from the proposed action would be substantially below the maximum allowable limits for a PSD Class II area.

Gaseous and fine particulate matter in the atmosphere can potentially degrade the atmospheric visibility. The visibility degradation is primarily due to the presence of particulates with the size in the range of 1 to 2 microns (micrometers). The sources of these particulates may come from fuel burning and the chemical transformation of the atmospheric constituents. The chemical transformation of NO_2, SO_2, and VOC may produce nitrates, sulfates, and carbonaceous particles. High humidity also may contribute to the visibility impairment in the Gulf coastal areas. Since future air emission from all sources in the area are expected to be about the same level as they have been or less, it is expected that the impact on visibility due to the presence of fine particulates would be, as previously determined, minor.

Summary and Conclusion

Emissions of pollutants into the atmosphere from the routine activities associated with the WPA proposed action are projected to have minimal impacts to onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline. Emissions from proposed-action activities are expected to be well within the NAAQS. As indicated in the GMAQS and other modeling studies, the proposed action would have only a small effect on ozone levels in ozone nonattainment areas and would not interfere with the States' schedule for compliance with the NAAQS. The OCD modeling results show that increases in onshore annual average concentrations of NO_x, SO_x, and PM_{10} are estimated to be less than the maximum increases allowed in the PSD Class II areas. Regulations, monitoring, mitigation, and developing emissions-related technologies would ensure these levels stay within the NAAQS.

4.1.1.1.3. Impacts of Accidental Events

Background/Introduction

A description of impacts of accidental events can be found in Chapter 4.4.1 of the Multisale EIS and in Chapter 4.1.1.3 of the 2009-2012 Supplemental EIS.

The accidental release of hydrocarbons related to the WPA proposed action would result in the emission of air pollutants. The OCS accidents would include the release of oil, condensate, or natural gas or chemicals used offshore or pollutants from the burning of these products. The air pollutants include criteria NAAQS pollutants, volatile and semi-volatile organic compounds, hydrogen sulfide, and methane. These pollutants are discussed in **Chapter 4.1.1.1.2** above. If a fire were associated with the accidental event, it would produce a broad array of pollutants, including all NAAQS-regulated primary pollutants, including NO_2, CO, SO_x, VOC, PM_{10}, and $PM_{2.5}$. The discussion below addresses a 15,000-bbl spill. In the spill size category of >10,000 bbl, the average of the largest historical spills is 15,000 bbl and is the average volume of two pipeline spills that occurred (Anderson and LaBelle, 2000).

A catastrophic event is a high-volume, long-duration oil spill or a "spill of national significance." An analysis of the impact of a catastrophic spill is included in **Appendix B**. Many Federal and State agencies and companies participate in a catastrophic event such as the DWH incident. Air quality onshore and on-water was monitored by the Occupational Safety and Health Administration (OSHA), USCG, and the responsible party to ensure a safe work environment for response workers. Coastal community air quality was monitored by USEPA and State environmental agencies. The results from these efforts are available on DWH event websites such as http://www.epa.gov/bpspill/air.html.

Proposed Action Analysis

The accidental release of hydrocarbons or chemicals from the WPA proposed action would cause the emission of air pollutants. Some of these pollutants are precursors to ozone, which is formed by complex photochemical reactions in the atmosphere. Accidents, such as oil spills and blowouts, are a source of emissions related to OCS operations. Typical emissions from OCS accidents consist of hydrocarbons; only fires produce a broad array of pollutants, including all NAAQS-regulated primary pollutants. The criteria pollutants considered here are NO_2, CO, SO_x, VOC, PM_{10}, and $PM_{2.5}$.

NAAQS Pollutants

Some of the NAAQS pollutants, the VOC's and NO_x, are precursors to ozone, which is formed by complex photochemical reactions in the atmosphere. Human exposure to ground-level ozone exposure causes a variety of health problems, including airway irritation, aggravation of asthma, and increased susceptibility to respiratory illnesses. Ozone levels could increase, especially if the oil spill were to occur on a hot, sunny day with sufficient concentrations of NO_x present in the lower atmosphere. An accidental spill would possibly have a temporary localized, offshore adverse effect due to NAAQS pollutant concentrations. Due to the distance from shore and an assumed accidental spill size of 15,000 bbl, an oil spill would not affect onshore ozone concentrations.

The VOC emissions from the evaporation of spilled oil can contribute to the formation of particulate matter ($PM_{2.5}$). In-situ burning also generates particulate matter. Particulate matter can cause adverse human respiratory effects and can also result in a haze.

Hydrocarbons

Oil is a mixture of many different chemical compounds, some of which are hazardous to health. Toxic chemicals can cause headache or eye irritation. Benzene can cause cancer at high levels and long exposures. The benzene, ethylbenzene, toluene, and xylene (BTEX fraction) of oil is light and volatilizes into air. The BTEX level is commonly measured to provide an indication of the level air quality. During an accidental spill, the levels of BTEX in the immediate area could exceed safe levels. In hazardous conditions, OSHA and USCG regulations require workers to use breathing protection. An accidental spill would possibly result in temporary localized, offshore elevated levels of hydrocarbons. Due to the distance to shore and an assumed accidental spill size of 15,000 bbl, an accidental spill would not result in elevated onshore BTEX concentrations. An analysis of the impact of a catastrophic spill, of far greater size, is included in **Appendix B**.

Hydrogen Sulfide (H_2S)

The presence of H_2S within formation fluids occurs sporadically throughout the Gulf of Mexico OCS and may be released during an accident. There has been some evidence that petroleum from deepwater contain significant amounts of sulfur. The H_2S concentrations in the OCS vary from as low as a fraction of a ppm to as high as 650,000 ppm. Hydrogen sulfide can cause acute symptoms, including headaches, nausea, and breathing problems. During an accidental event, H_2S concentrations could be high enough in the immediate area to be life threatening. The BOEMRE's regulations (30 CFR 250.490(a)(1)) and the clarifying Hydrogen Sulfide NTL (NTL 2009-G31) require a Contingency Plan as well as sensors and alarms to alert and protect workers from H_2S releases.

In-situ Burning

In-situ burning of a spill results in emissions of NO_2, SO_2, CO, and PM_{10}, and would generate a plume of black smoke. Fingas et al. (1995) describes the results of a monitoring program of a burn experiment at sea. The program involved extensive ambient measurements during two experiments in which approximately 300 bbl of crude oil were burned. It found that, during the burn, CO, SO_2, and NO_2 were measured only at background levels and were frequently below detection levels. Ambient levels of VOC were high within about 100 m (328 ft) of the fire but were significantly lower than those associated with a nonburning spill. Measured concentrations of polycyclic aromatic hydrocarbons (PAH's) were low. It appeared that a major portion of these compounds was consumed in the burn. In measurements taken from the NOAA WP-3D aircraft, lofted plumes from the controlled burns rose above the marine boundary layer of 2,000 ft (610 m) (Ravishankara and Goldman, 2010).

McGrattan et al. (1995) modeled smoke plumes associated with in-situ burning. The results showed that the surface concentrations of particulate matter did not exceed the health criterion of 150 $\mu g/m^3$ beyond about 5 km (3 mi) downwind of an in-situ burn. This is quite conservative as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration. This appears to be supported by field experiments conducted off of Newfoundland and in Alaska. In summary, the impacts from in-situ burning are temporary. Pollutant concentrations would be expected to be within the NAAQS. The air quality impacts from in-situ burning would therefore be minor.

Dioxins and furans are a family of extremely persistent chlorinated compounds that magnify in the food chain. During an in-situ burn, the conditions exist (i.e., incomplete hydrocarbon combustion and the presence of chlorides in seawater) where dioxins and furans could potentially form. Measurements of dioxins and furans during the DWH event in-situ burning were made (Aurell and Gullett, 2010). The estimated levels of dioxins and furans produced by the in-situ burns were similar to those from residential woodstove fires and slightly lower than those from forest fires, according to USEPA researchers (Schaum et al., 2010) and, thus, concerns about bioaccumulation in seafood were alleviated.

Flaring

Flaring may be conducted to manage excess natural gas during an accidental event such as damage to a pipeline that transports the gas to shore. For the DWH event, a flare that burned both oil and gas was employed. Flaring would result in the release of NO_x emissions from the flare. The SO_2 emissions would be dependent on the sulfur content of the crude oil.

Particulate matter from the flare would also affect visibility. In-situ burning and flaring are temporary efforts to limit environmental impact during an accidental spill. Flaring needs to be approved by BOEMRE's Regional Director. The appropriate agencies would monitor for worker safety. Pollutant concentrations onshore would be expected to be within the NAAQS and not to have onshore impacts.

Dispersants

Dispersants may be applied to break up surface and subsurface oil following an accidental spill. In surface application, aircraft fly over the spill, similar to crop dusting on land, and spray dispersants on the visible oil. Dispersant usage is usually reserved for offshore locations. There is the possibility that the dispersant mist can drift from the site of application to a location where workers or the community are exposed by both skin contact and inhalation. Following the DWH event, USEPA provided the Trace Atmospheric Gas Analyzers bus, a mobile laboratory, to perform instantaneous analysis of air in coastal communities. Two ingredients in the *Corexit* dispersant were measured. Very low levels of dispersants were identified. Due to the distance to shore and an assumed accidental spill size of 15,000 bbl, it is unlikely that dispersants would be carried to onshore areas.

Summary and Conclusion

Accidental events associated with the WPA proposed action that could impact air quality include spills of oil, natural gas, condensate, and refined hydrocarbons; H_2S release; fire; and NAAQS air pollutants (i.e., SO_x, NO_x, VOC's, CO, PM_{10}, and $PM_{2.5}$). Response activities that could impact air quality include in-situ burning, the use of flares to burn gas and oil, and the use of dispersants applied from aircraft. Measurements taken during an in-situ burning show that a major portion of compounds was consumed in the burn; therefore, pollutant concentrations would be expected to be within the NAAQS. In a recent analysis of air in coastal communities, low levels of dispersants were identified. These response activities are temporary in nature and occur offshore; therefore, there are little expected impacts from these actions to onshore air quality.. Accidents involving high concentrations of H_2S could result in deaths as well as environmental damage. Regulations and NTL's are in place to protect workers from H_2S releases. Other emissions of pollutants into the atmosphere from accidental events as a result of the WPA proposed action are not projected to have significant impacts on onshore air quality because of the prevailing atmospheric conditions, emissions height, emission rates, and the distance of these emissions from the coastline. These emissions are not expected to have concentrations that would change onshore air quality classifications.

Overall, since loss of well-control events and blowouts are rare events and of short duration, potential impacts to air quality are not expected to be significant, except in the rare case of a catastrophic event. The summary of vast amounts of data collected and additional studies will provide more information in the future.

4.1.1.1.4. Cumulative Impacts

Background/Introduction

An impact analysis for cumulative impacts in the WPA can be found in Chapter 4.5.1 of the Multisale EIS and in Chapter 4.1.1.4 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and in the 2009-2012 Supplemental EIS. This cumulative analysis summary considers OCS and non-OCS activities that could occur and adversely affect onshore air quality from OCS sources during the 40-year analysis period.

The activities in the cumulative scenario that could potentially impact onshore air quality include the proposed action and the OCS Program; State oil and gas programs; other major factors influencing offshore environments; onshore non-OCS activities; accidental releases from an oil spill; accidental releases of hydrogen sulfide; natural events (e.g., hurricanes); and a catastrophic oil spill.

The activities for the OCS Program include the drilling of exploration, delineation, and development wells; platform installation; and service-vessel trips, flaring, and fugitive emissions. Emissions of pollutants into the atmosphere from the activities associated with the OCS Program are not projected to have significant effects on onshore air quality because of the prevailing atmospheric conditions, emission rates and heights, and the resulting pollutant concentrations. Onshore impacts on air quality from emissions from OCS activities are estimated to be within PSD Class II allowable increments. In a BOEMRE study, the modeling results indicate that the cumulative impacts are well within the PSD Class I allowable increment (Wheeler et al., 2008). The OCS contribution to the air quality problem in the coastal areas is small, but the total impact from onshore and offshore emissions would be significant to the ozone nonattainment areas in southeast Texas and the parishes near Baton Rouge, Louisiana.

State oil and gas programs onshore, in territorial seas, and in coastal waters also generate emissions that affect onshore air quality. These emissions are regulated by State agencies and/or USEPA. Reductions in these emissions have been achieved through the use of low sulfur fuels, catalytic reduction, and other efforts, and as a result, they also constitute minor impacts to onshore air quality.

Other major factors influencing offshore environments such as sand borrowing and transportation also generate emissions that can affect air quality. These emissions are regulated by State agencies and/or USEPA. Reductions have been achieved through the use of low sulfur fuels and catalytic reduction and other efforts, and as a result, constitute minor impacts to onshore air quality.

Other major onshore emission sources from non-OCS activities include power generation, industrial processing, manufacturing, refineries, commercial and home heating, and motor vehicles. The total impact from the combined onshore and offshore emissions would be significant to the ozone nonattainment areas in southeast Texas and the parishes near Baton Rouge, Louisiana.

Portions of the Gulf Coast have ozone levels that exceed the Federal air quality standard. Ozone levels are on a declining trend because of air-pollution control measures that have been implemented by the States. This downward trend is expected to continue as a result of local as well as nationwide air-pollution control efforts. However, a more stringent air quality standard has recently been implemented by USEPA, which may result in increasing the number of parishes/counties in the coastal states in violation of the Federal ozone standard. There is also a proposal to further decrease the ozone standard. If the ozone standard was lowered, although OCS emissions from the proposed action would not vary, the OCS emissions in those newly designated areas would have an incrementally larger contribution to the onshore ozone levels. Although air quality is improving, the number of areas in nonattainment has increased due to more stringent standards.

The Gulf Coast has significant visibility impairment from anthropogenic emission sources. Area visibility is expected to improve somewhat as a result of regional and national programs to reduce emissions.

Impacts from oil spills for the cumulative scenario for this lease sale would be similar to those stated in the 2007-2012 leasing program. The spill could be crude oil, crude oil with a mixture of natural gas, or refined fuel. Air quality would be affected by the additional response vessel traffic, volatilization of components of the oil, and natural gas if released. Impacts from individual spills would be localized and temporary.

The scenario of an accidental release of H_2S is described in **Chapter 3.1.1.5.1**. The same safety precautions and regulations described in the proposed action are applicable to the cumulative scenario. That is, a typical safety zone of several kilometers is usually established in an area with the concentration of H_2S greater than 20 ppm from the source or a platform. In the event of H_2S releases, a contingency plan is required.

The effects of hurricanes on the offshore infrastructure are described in **Chapters 3.1.1.5.3 and 3.3.7.2**. Hurricanes mainly cause damage to offshore infrastructures and pipelines, which may result in an oil spill. A hurricane would cause minor effects on the onshore air quality since air emissions in the event of a hurricane are temporary sources. For the cumulative scenario, the emissions from oil-spill and repair activities are expected to be the same as the proposed action and to have minimum effects on the onshore air quality.

The impacts of accidental events and the DWH event are briefly described in **Chapter 4.1.1.3 and Appendix B**. The DWH event may have the potential to cause effects on air quality and public health and the environment, which may occur from the application of dispersants to an oil spill, in-situ oil burning, evaporation of toxic chemicals from oil spill, and cleanup activities. These events would release and transport the particulate matter to the onshore environment and increase the ozone concentration or the amount of toxic chemicals in the onshore environment. The onshore residents and cleanup workers may be exposed to toxic chemicals, particulate matter, or ozone, and they may experience short-term or long-term health effects. It has been noted in de Gouw et al. (2011) and Gong et al. (2011) that lighter, more soluble hydrocarbons, like those seen in the DWH event, were dissolved or biodegraded during the transit from the wellhead to the surface."

Modeling tools for the transport and dispersion of air pollutants such as ozone, carbon monoxide, nitrogen dioxide, and PAH's are required to determine the fate and pollutant concentrations in the environment and, subsequently, for the assessment of environmental impacts. It appears that these tools are currently not available for the application to the offshore environment, which are needed to be developed, especially for the long-range transport of air pollutants.

In a catastrophic spill, oil may be burned to prevent it from entering sensitive habitats. The USEPA released two peer-reviewed reports concerning dioxins emitted during the controlled burns of oil during the DWH event (Aurell and Gullett, 2010; Schaum et al., 2010). Dioxins is a category that describes a group of hundreds of potentially cancer-causing chemicals that can be formed during combustion or burning. The reports found that, while small amounts of dioxins were created by the burns, the levels that workers and residents would have been exposed to were below USEPA's levels of concern.

However, at present, a number of scientists, doctors, and health care experts are concerned with the potential public health effects as a result of DWH event in the Gulf of Mexico, and they found that VOC benzene, a cancer causing agent, has been found above Louisiana's ambient air quality standards.

The effects of DWH event on public health and the environmental can be classified as the short-term and long-term effects. The short-term effect includes watery and irritated eyes, skin itching and redness, coughing, and shortness of breath or wheezing. As yet, little is know about the long-term health effects of direct exposure to the DWH event. Past accidental events of oil spills do not provide guidance for the assessment of the long-term impact of the DWH event on public health.

A survey of major oil-spill events in the past indicates that the long-term effects of an oil spill on human health and the environment are still unknown. Several large oil-spill incidents include the *Ixtoc I* oil spill accident in the Bay of Campeche of the Gulf of Mexico on June 3, 1979; the *Exxon Valdez* oil spill in Prince William Sound, Alaska, in 1989; the *Prestige* oil spill in the Atlantic Ocean near Spain in 2002; and the DWH event in the Gulf of Mexico in 2010.

The *Ixtoc* oil-spill accident occurred in the Bay of Campeche of the Gulf of Mexico on June 3, 1979. This oil spill became one of the largest oil spills in history at that time (Jernelöv and Linden, 1981). It was estimated that an average of approximately 10,000-30,000 bbl of oil per day were discharged into the Gulf of Mexico and it was finally capped on March 23, 1980. Ocean currents carried the oil and reached as far as the Texas coastline. There is no study of the long-term impact of air quality from this oil spill on the human health.

The DWH event occurred in 2010. To assess the effects of the BP oil spill on human health and the environment, the Institute of Medicine held the workshop, "Assessing the Human Health Effects of the Gulf of Mexico Oil Spill," in New Orleans, Louisiana, on June 22-23, 2010. In this workshop, it has been reported that people in the coastal areas showed the stresses and strains of living with the effects of the spill on their livelihood and their way of life (McCoy and Salerno, 2010). In summary, there is no study of the long-term impact of air quality on the human health in the history of oil spills. Although there are minimal studies, some lessons can be learned from the 1991 Kuwati oil-field fires and the effects of oil burning to the DWH event. In the Kuwati event, 600 oil wells were set in flame. These burnings produced a composite smoke plume of gaseous constituents (e.g., NO_x, SO_x, CO_2, etc.), acid aerosols, VOC's, metal compounds, PAH's, and particulate matter. Military personnel deployed to the Persian Gulf War have reported a variety of symptoms attributed to their exposures, including asthma and bronchitis (Lange et al., 2002).

Summary and Conclusion

Emissions of pollutants into the atmosphere from the activities associated with the OCS Program are not projected to have significant effects on onshore air quality because of the prevailing atmospheric conditions, emission rates and heights, and the resulting pollutant concentrations. Reductions in emissions have been achieved through the use of low sulfur fuels, catalytic reduction, and other efforts and, as a result, such emissions constitute minor impacts to onshore air quality. Onshore impacts on air quality from emissions from OCS activities are estimated to be within PSD Class II allowable increments. The modeling results indicate that the cumulative impacts to a PSD Class I Area are well within the PSD Class I allowable increment (Wheeler et al., 2008).

Ozone levels are on a declining trend because of air-pollution control measures that have been implemented by the States. This downward trend is expected to continue as a result of local as well as nationwide air-pollution control efforts.

The Gulf Coast has significant visibility impairment from anthropogenic emission sources. Area visibility is expected to improve somewhat as a result of regional and national programs to reduce emissions.

The incremental contribution of the proposed action (as analyzed in Chapter 4.2.1.1.1 of the Multisale EIS) to the cumulative impacts is not significant and is not expected to alter onshore air quality classifications because of the prevailing atmospheric conditions, emission rates and mixing heights, and the resulting pollutant concentrations. Portions of the Gulf Coast have ozone levels that exceed the Federal air quality standard, but the incremental contribution from the proposed action is very small. The cumulative contribution to visibility impairment from the proposed action is also expected to remain very small. Area visibility is expected to improve somewhat as a result of regional and national programs to reduce emissions. The proposed action would have an insignificant effect on ozone levels in ozone nonattainment areas and would not interfere with the States' schedule for compliance with the NAAQS. However, more stringent air quality standards have recently been implemented by USEPA; these standards may result in increasing the number of counties in the coastal states that are in violation of the Federal air quality standard, but they would also increase the applicability of air quality regulations.

There are few studies on the long-term impact of air quality on human health and the environment in the history of oil spills. Each incident is different and exposure factors vary. Therefore, the long-term effects on human health and the environment are still unknown.

4.1.1.2. Water Quality

For the purposes of this Supplemental EIS, water quality is the ability of a waterbody to maintain the ecosystems it supports or influences. In the case of coastal and marine environments, the quality of the water is influenced by the rivers that drain into the area, the quantity and composition of wet and dry atmospheric deposition, and the influx of constituents from sediments. Besides the natural inputs, human activity can contribute to diminished water quality through discharges, run-off, dumping, air emissions, burning, and spills. Also, mixing or circulation of the water can either improve the water through flushing or be the source of factors contributing to the decline of water quality.

Evaluation of water quality is done by the measurement of factors that are considered important to the health of an ecosystem. The primary factors influencing coastal and marine environments are temperature, salinity, dissolved oxygen, nutrients, potential of hydrogen (pH), oxidation reduction potential (Eh), pathogens, and turbidity or suspended load. Trace constituents such as metals and organic compounds can affect water quality. The water quality and sediment quality may be closely linked. Contaminants, which are associated with the suspended load, may ultimately reside in the sediments rather than the water column.

The region under consideration is divided into coastal and offshore waters for the following discussion. Coastal waters, as defined by BOEMRE, include all the bays and estuaries from the Rio Grande River to Florida Bay (**Figure 4-2**). Offshore waters, as defined in this Supplemental EIS, includes both State offshore water and Federal OCS waters, which includes everything outside any barrier islands to the Exclusive Economic Zone. The inland extent is defined by the Coastal Zone Management Act.

The BOEMRE has reexamined the analysis for water quality presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusion for water quality presented in the Multisale EIS and the 2009-2012 Supplemental EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS. A summary of those analyses and their reexamination due to new information is presented in the following sections. A brief summary of potential impacts follows. Impacts from routine activities associated with the proposed action would be minimal if all existing regulatory requirements are met. Coastal water impacts associated with routine activities include increases in turbidity resulting from pipeline installation and navigation canal maintenance, discharges of bilge and ballast water from support vessels, and run-off from shore-based facilities. Offshore water impacts associated with routine activities result from the discharge of drilling muds and cuttings, produced water, residual chemicals used during workovers, structure installation and removal, and pipeline placement. The discharge of drilling muds and cuttings causes temporary increased turbidity and changes in sediment composition. The discharge of produced water results in increased concentrations of some metals, hydrocarbons, and dissolved solids within an area of about 100 m (328 ft) adjacent to the point of discharge. Structure installation and removal and pipeline placement disturbs the sediments and causes increased turbidity. In addition, offshore water impacts result from supply and service-vessel bilge and ballast water discharges.

Small spills (<1,000 bbl) are not expected to significantly impact water quality in coastal or offshore waters. Large spills (≥1,000 bbl), however, could impact water quality in coastal waters. Accidental chemical spills, release of SBF's, and blowouts would have temporary localized impacts on water quality.

The activity associated with the proposed action would contribute a small percentage of the existing and future OCS energy industry. The specific discharges, drill muds, cuttings and produced water, and accidents resulting in spills would occur in proportion to production and, therefore, would add a small increase to the anticipated impacts. Furthermore, the vessel traffic and related discharges associated with the proposed action are a fraction of the ongoing commercial shipping and military activity in the Gulf. The impacts of discharges, sediment disturbances, and accidental releases are a small percentage of the overall activity and the overall impacts to coastal and offshore waters.

4.1.1.2.1. Coastal Waters

4.1.1.2.1.1. Description of the Affected Environment

A detailed description of coastal water quality can be found in Chapter 3.1.2.1 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.2.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The Gulf of Mexico is the ninth largest waterbody in the world (USDOC, NOAA, 2008a). The description of the physical oceanography of the Gulf of Mexico is described in Appendix A.2 of the Multisale EIS. The United States' portion of the Gulf of Mexico region follows the coastline of five states from the southern tip of Texas moving eastward through Louisiana, Mississippi, Alabama, and ending in the Florida Keys (**Figure 4-2**). The combined coastline of these states totals over 47,000 mi (75,639 km) (when including the shores of all barrier islands, wetlands, inland bays, and inland bodies of water) (USDOC, NOAA, 2008a). The Gulf's coastal areas contain half the wetlands in the United States (USDOC, NOAA, 2008a). Wetlands are discussed in further detail in **Chapter 4.1.1.4**. According to USEPA (2008a), the Gulf Coast coastal area comprises over 750 bays, estuaries, and sub-estuary systems that are associated with larger estuaries. Gulf Coast estuaries and wetlands provide important spawning, nursery, and feeding areas for a wide array of fish wildlife, as well as being the home for a wide range of indigenous flora and fauna (USEPA, 2008a). The coastal waters of the Gulf Coast are an extremely productive natural system (USEPA, 2008a), which is also important to the Gulf Coast economy, as the major commercial fishing ports in the region yield over 1.2 billion pounds of seafood on an annual basis (USDOC, NOAA, 2008a). The natural resources of the Gulf of Mexico are also important for tourism and recreation.

Over 150 rivers empty out of North America into the Gulf of Mexico (Gore, 1992, p. 127). The rivers emptying into the Gulf bring freshwater and sediment into coastal waters (Gore, 1992, pp. 127-131), which affects the water quality of these waters. Rivers carry excess nutrients (e.g., nitrogen and phosphorus), as well as other possible inputs such as contaminants from industrial wastewater discharge, downstream; and this effect is cumulative as the river reaches an estuary (Gore, 1992, pp. 280 and 291). Overenrichment of nutrients may lead to eutrophication, which can eventually cause algal blooms and fish kills (Gore, 1992, p. 280) (see below for more information on nutrient enrichment and its effects; also see the wetlands and seagrasses discussions in **Chapters 4.1.1.4** and **4.1.1.5**, respectively). The emptying of rivers into the GOM is part of the hydrologic cycle or water cycle (USDOI, GS, 2010a); understanding this cycle not only explains the movement of water on Earth but also how water quality might be affected by both natural and anthropogenic sources. The water cycle may introduce components into the GOM through waterbodies emptying into the GOM, runoff, groundwater discharge, or precipitation. Besides nutrients, water quality is generally gauged by measuring a series of parameters commonly including, but not limited to, temperature, salinity, dissolved oxygen, pH, Eh, pathogens, and turbidity. The study of water quality may also examine possible pollutants such as metals and organic compounds. Water quality in coastal waters of the northern Gulf of Mexico is highly influenced by season. For example, salinity in open water near the coast may vary between 29 and 32 practical salinity units (psu) during fall and winter, but it may decline to 20 psu during spring and summer due to increased runoff (USDOI, MMS, 2000). Oxygen and nutrient concentrations also vary seasonally.

The priority water quality issues identified by the Gulf of Mexico Alliance are (1) reducing risk of exposure to disease-causing pathogens, (2) minimizing occurrence and effects of harmful algal blooms, (3) identifying sources of mercury in Gulf seafood, and (4) improving the monitoring of Gulf water resources (Gulf of Mexico Alliance, 2009a). In addition to water quality itself, nutrients and nutrient impacts are also a regional priority issue for the organization (Gulf of Mexico Alliance, 2009b).

The leading source of contaminants that impair coastal water quality is urban runoff. Urban runoff can include suspended solids, heavy metals and pesticides, oil and grease, and nutrients. Urban runoff increases with population growth, and the Gulf Coast region has experienced a 103 percent population growth since 1970 (USDOC, NOAA, 2008a). Other pollutant source categories include (1) agricultural runoff, (2) municipal point sources, (3) industrial sources, (4) hydromodification (e.g., dredging), and (5) vessel sources (e.g., shipping, fishing, and recreational boating).

The National Research Council (NRC, 2003, Table I-4, p. 237) estimated that, on average, approximately 26,324 bbl of oil per year entered Gulf waters from petrochemical and oil refinery industries in Louisiana and Texas. Further, NRC (2003) calculated an estimate for oil and grease loads from all land-based sources per unit of urban land area for rivers entering the sea. The Mississippi River introduced approximately 3,680,938 bbl of oil and grease per year from land-based sources (NRC, 2003, Table I-9, p. 242) into the waters of the Gulf of Mexico.

The zone of hypoxia on the Louisiana-Texas shelf occurs seasonally and is affected by the timing of the Mississippi and Atchafalaya Rivers' discharges carrying nutrients to the surface waters. The hypoxic conditions last until local wind-driven circulation mixes the water again. The 2010 GOM dead zone covered 20,000 km^2 (7,722 mi^2) (LUMCON, 2010a). The formation of the hypoxic zone was attributed to nutrients from the Mississippi River fueling enhanced phytoplankton growth. The 2010 dead zone was reported to be one of the largest ever. The area reported in 2009 measured 8,000 km^2 (3,000 mi^2) (LUMCON, 2009), while the area reported in 2008 measured 20,720 km^2 (8,000 mi^2) (LUMCON, 2008).

Separate zones of hypoxia have been discovered 5-15 mi (8-24 km) off the coast of Texas and are likely the result of freshwater inputs generated in Texas and summer upwelling. In 2007 a Texas-created dead zone was discovered and attributed to excessive rainfall and runoff into the Brazos River (LUMCON, 2010b).

Since the marine environment is a dynamic system, sediment quality and water quality can affect each other. For example, a contaminant may react with the mineral particles in the sediment and be removed from the water column (e.g., adsorption). Thus, under appropriate conditions, sediments can serve as sinks for contaminants such as metals, nutrients, or organic compounds. However, if sediments are (re)suspended (e.g., due to dredging or a storm event), the resuspension can lead to a temporary redox flux, including a localized and temporal release of any formally sorbed metals as well as nutrient recycling (Caetano et al., 2003; Fanning et al., 1982).

The overall coastal condition of the Gulf Coast was evaluated from 2001 to 2002 by USEPA and was rated as fair to poor (USEPA, 2008a). Specifically, water quality was rated as fair while sediment quality and the coastal habit index, a rating of wetlands habitat loss, both of which affect water quality, were rated as poor. The USEPA also conducted similar evaluations from 1990 to 1996 (USEPA, 2001) and again from 1997 to 2000 (USEPA, 2005). Water quality was poor overall in the first Coastal Condition Report, but it increased to fair overall in the latter reports. Conversely, sediment quality was generally fair in the first two reports and decreased to poor in the last report. The Barataria/Terrebonne Estuary, near Port Fourchon, which is a common service base, was ranked fair in terms of water quality (USEPA, 2007b) and was assessed as having moderately high eutrophic conditions by NOAA (Bricker et al., 2007). The Galveston Bay estuary system was ranked poor in terms of water quality and fair to poor in terms of sediment quality (USEPA, 2007b); Galveston Bay was individually characterized as having moderately low eutrophic conditions (Bricker et al., 2007). The estuarine area of the Coastal Bend Bays, which includes Corpus Christi Bay, was ranked fair in terms of water quality and poor in terms of sediment quality (USEPA, 2007b), while Corpus Christi Bay alone was characterized as moderately eutrophic (Bricker et al., 2007).

The condition of the Gulf Coast was altered by the DWH event and associated oil spill. The Government estimated that approximately 4.9 million barrels of oil were released during the DWH event (Oil Spill Commission, 2011c) and that approximately 1.84 million gallons of dispersant were used to breakup and dilute the oil subsea at the wellhead and on the surface (Oil Spill Commission, 2011d). As well, the corresponding emission of methane from the wellhead during the DWH event was estimated between 9.14×10^9 and 1.25×10^{10} moles (Kessler et al., 2011). In coastal waters, the maximum extent of surface water and shoreline oiling stretched from roughly the Louisiana-Texas border to Apalachicola, Florida (Oil Spill Commission, 2011c, Figure 7.1). As well, a subsurface oil and gas plume was discovered in deep waters between ~1,100 and 1,300 m (3,609 and 4,265 ft) (e.g., Diercks et al., 2010). Based on in-situ fluorescence and oxygen measurements (proxies for oil concentration and biodegradation, respectively), the subsurface plume traveled to the northeast of the wellhead and much farther to the southwest, reaching as far west as approximately -93.0° (e.g., Kessler et al., 2011). Thus, based on these observations, few (if any) water quality impacts on the WPA itself by the DWH event have been documented.

Tarballs found in the surf on Bolivar Peninsula near Galveston were identified as coming from the DWH event. However, the lack of weathering of the oil raised doubts that the oil had traversed the Gulf from the spill source (RestoreTheGulf.gov, 2010a). One theory was that the oil was transported by a response vessel. Rapid assessment teams were established in Galveston and Port Arthur to respond to and investigate reports of oil.

4.1.1.2.1.2. Impacts of Routine Events

Background/Introduction

A detailed description of routine impacts on coastal water quality can be found in Chapter 4.2.1.1.2.1 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.2.1.2 of the 2009-2012 Supplemental EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

The routine activities associated with the WPA proposed action that would impact water quality include the following:

- discharges during drilling of exploration and development wells;
- structure installation and removal;
- discharges during production;
- installation of pipelines;
- workovers of wells,
- maintenance dredging of existing navigational canals;

- service vessel discharges; and
- nonpoint-source runoff.

The scenario information related to the WPA proposed action is presented in **Table 3-2**.

Sediment disturbance and turbidity may result from nearshore pipeline installation or maintenance dredging. The installation of pipelines can increase the local total suspended solids in the water. The adverse effect on water quality would be temporary and localized. Chapter 4.1.2.1.7 of the Multisale EIS notes that COE and State permits would require these turbidity impacts to be mitigated through the use of turbidity screens and other turbidity reduction or confinement equipment. No new navigation channels are expected to be dredged as a result of the WPA proposed action, but the WPA proposed action would contribute to maintenance dredging of existing navigation canals. Maintenance dredging will temporarily increase turbidity levels in the vicinity of the dredging and disposal of materials.

In coastal waters, the water quality would be impacted by the discharges from the service vessels in port. Service-vessel round trips projected for the WPA proposed action are 76,000-141,000 trips over the 40-year life of the proposed action (**Table 3-2**). Based on current service-base usage, it is assumed the majority of these trips would occur in Texas' coastal waters. The types of discharges and regulations are discussed in Chapters 4.1.1.4.8 and 4.1.2.2.2 of the Multisale EIS. Most discharges are treated or otherwise managed prior to release. In coastal waters, bilge and ballast water may be discharged with an oil content of 15 ppm or less (33 CFR 151.10). The discharges would affect the water quality locally. However, regulations are becoming more stringent. The USCG Ballast Water Management Program became mandatory for some vessels in 2004 (33 CFR 151 Subparts C and D) (U.S. Dept. of Homeland Security, CG, 2010b). The goal of the program was designed to prevent the introduction on nonindigenous (invasive) species that would affect local water quality. Furthermore, USCG published the Ballast Water Discharge Standard Notice of Proposed Rulemaking in the *Federal Register* on August 28, 2009 (*Federal Register*, 2009c). Additionally, the final Vessel General Permit, issued by USEPA, became effective on December 19, 2008. This permit is in addition to already existing NPDES permit requirements and now increases the NPDES regulations so that discharges incidental to the normal operation of vessels operating as a means of transportation are no longer excluded unless exempted from NPDES permitting by Congressional legislation (USEPA, 2008a).

Up to one new gas processing plant is projected as a result of the WPA proposed action. In addition, the WPA proposed action would contribute to the use of existing onshore facilities in Texas, Louisiana, and possibly Mississippi and Alabama. These supporting onshore facilities would discharge into local wastewater treatment plants and waterways during routine operations; the types of onshore facilities were discussed in Chapter 4.1.2.2.1 of the Multisale EIS. All point-source discharges are regulated by USEPA, the agency responsible for coastal water quality, or the USEPA-authorized State agency. The U.S. Environmental Protection Agency's NPDES storm-water effluent limitation guidelines control storm-water discharges from support facilities. Indirect impacts could occur from nonpoint-source runoff, such as rainfall, which has drained from infrastructure such as a public road and parking lot, and may contribute hydrocarbons, trace-metal pollutants, and suspended sediments. These indirect impacts would be minimal, as long as existing regulations are followed, and difficult to discern from other sources.

Summary and Conclusion

The primary impacting sources to water quality in coastal waters are point-source and storm-water discharges from support facilities, vessel discharges, and nonpoint-source runoff. These activities are not only highly regulated but are also localized and temporary in nature. The impacts to coastal water quality from routine activities associated with the WPA proposed action should be minimal because of the distance to shore of most routine activities, USEPA's regulations that restrict discharges, and the few, if any, new pipeline landfalls or onshore facilities that would be constructed, .

4.1.1.2.1.3. Impacts of Accidental Events

Background/Introduction

A detailed description of accidental events on coastal water quality can be found in Chapter 4.4.2.1 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.2.1.3 of the 2009-2012 Supplemental EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Accidental events associated with the WPA proposed action that could impact coastal water quality include spills of oil and refined hydrocarbons, releases of natural gas, spills of chemicals or drilling fluids, and loss of well control, collisions, or other malfunctions that would result in such spills. **Chapter 3.2** discusses the accidental events that could result from the impact-producing factors and scenario, with particular attention given to the risk of oil spills, response to such oil spills, loss of well control, pipeline failures, vessel collisions, and chemical and drilling fluid spills. A brief summary is presented here. The impacts of rare, catastrophic spills are discussed in **Appendix B**. A catastrophic event would not be expected to occur in coastal waters, but a catastrophic spill in offshore waters could affect coastal waters.

Proposed Action Analysis

Oil Spills and Natural Gas and Condensate Releases

Water quality is altered and degraded by oil spills through the increase of petroleum hydrocarbons and their various transformation/degradation products in the water. The extent of impact from a spill depends on the behavior and fate of oil in the water column (e.g., the movement of oil and the rate and nature of weathering), which, in turn, depends on oceanographic and meteorological conditions at the time (Appendices A.2 and A.3 of the Multisale EIS). Crude oils are not a single chemical, but instead are complex mixtures with varied compositions. The various fractions within the crude behave differently in water; thus, the behavior of the oil and the risk that the oil poses to natural resources depends on the composition of the specific oil encountered (Michel, 1992). Generally, oils can be divided into three groups of compounds: (1) light-weight; (2) medium-weight; and (3) heavy-weight components. **Chapter 3.2.1** further characterizes the components of oil and discusses oil spills. Chapter 4.3.1 of the Multisale EIS also discusses oil spills in further detail, with Chapter 4.3.1.4 of the Multisale EIS describing the characteristics of OCS oil. Generally, the lighter ends of the oil are more water soluble and would contribute to acute toxicity. As the spill weathers, the aromatic components at the water's surface are more likely to exit the water. The heavier fractions are less water soluble and would partition to organic matter. This fraction is more likely to persist in sediments and would contribute to longer-term impacts.

In addition to oil, natural gas may also be explored for or produced in the GOM. Wells and sidetracks may produce a mixture of both oil and natural gas. Condensate is a liquid hydrocarbon phase that generally occurs in association with natural gas. The quality and quantity of components in natural gas vary widely by the field, reservoir, or location from which the natural gas is produced. Although there is not a "typical" makeup of natural gas, it is primarily composed of methane (NaturalGas.org, 2010b). Thus, if natural gas were to leak into the environment, methane may be released to the environment. Methane is a carbon source, such as oil, and its introduction into the marine environment could result in lowering dissolved oxygen levels due to microbial degradation. Unfortunately, little is known about the toxicity of natural gas and its components in the marine environment, but there is concern as to how methane in the water column might affect fish (**Chapter 4.1.1.13**).

The National Academy of Sciences (NRC, 2003), Patin (1999), and Boesch and Rabalais (1987) have reviewed the fate and effects of spilled oil and, to a lesser degree, natural gas releases. Chapter 4.3.1.7 of the Multisale EIS presents the risk of coastal spills associated with the proposed action, and **Chapter 3.2.1.3** of this Supplemental EIS supplements and updates that information. Spills in coastal waters could occur at storage or processing facilities supporting the OCS oil and gas industry or from the transportation of OCS-produced oil through State offshore waters and along navigation channels, rivers, and through coastal bays. For coastal spills, two additional factors that must be considered are the shallowness of the area the spill is in and the proximity to shore. Spills in coastal waters are more likely to be in shallow waters than offshore spills. Spills near the shore are less likely to be diluted since the volume of water in shallow waters is less than in deep waters. Furthermore, spills are more likely to contact land as there is less distance from the spill to land and less time for the oil to weather before it reaches the shore. Since oil does not mix with water and is usually less dense, most of the oil forms a slick at the surface. Small droplets in the water may adhere to suspended sediment and be removed from the water column. Oil may also penetrate sand on the beach or be trapped in wetlands, where it can be re-released into the water some time after the initial spill.

In the case of an accidental event, it is likely that response efforts would reduce the amount of oil. **Chapter 3.2.1.5** provides a further discussion of oil-spill-response considerations. Coastal water quality would not only be impacted by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts. Increased vessel traffic, hydromodification (e.g., dredging, berm building, etc.), and the addition of dispersants and methanol to the marine environment in an effort to contain, mitigate, or clean up the oil may also tax the environment to some degree.

One standard tool used in response to spilled oil on water is dispersants. Dispersants are not preauthorized for use in coastal areas (NRC, 2005), but it is possible that the use of dispersants in offshore spills may have effects on coastal environments. The purpose of chemical dispersants is to facilitate the movement of oil into the water column in order to encourage weathering and biological breakdown of the oil (i.e., biodegradation) (NRC, 2005; Australian Maritime Safety Authority, 2010). If the oil moves into the water column and is not on the surface of the water, it is less likely to reach sensitive shore areas (USEPA, 2010e). The toxicity of dispersed oil in the environment will depend on many factors, including the effectiveness of the dispersion, temperature, salinity, the degree of weathering, type of dispersant, and degree of light penetration in the water column (NRC, 2005). The toxicity of dispersed oil is primarily due to the toxic components of the oil itself (Australian Maritime Safety Authority, 2010).

Fortunately, over time, natural processes can physically, chemically, and biologically degrade oil (NRC, 2003). The physical processes involved include evaporation, emulsification, and dissolution; the primary chemical and biological degradation processes include photooxidation and biodegradation (i.e., microbial oxidation).

Chemical Spills

A study of chemical spills from OCS activities determined that accidental releases of zinc bromide and ammonium chloride could potentially impact the marine environment (Boehm et al., 2001). Both of these chemicals are used for well treatment or completion and are not in continuous use; thus, the risk of a spill is small. Most other chemicals are either relatively nontoxic or used in such small quantities that a spill would not result in measurable impacts. Zinc bromide is of particular concern because of the toxic nature of zinc. Close to the release point of an ammonium chloride spill, the ammonia concentrations could exceed toxic levels.

Pipeline Failures

A pipeline failure would result in the release of crude oil, condensate, or natural gas; the impacts of which are discussed above. Pipeline failures are discussed in more detail in **Chapter 3.2.3**.

Fuel Oil Spills from Collisions

A collision may result in the spillage of crude oil, refined products such as diesel, or chemicals. Crude oil and chemicals are discussed in the preceding paragraphs. Diesel is the type of refined hydrocarbon spilled most frequently as the result of a collision. Minimal impacts result from a spill since diesel is light and would evaporate and biodegrade within a few days (USDOC, NOAA, 2006). A collision could result in the release of up to the entire contents of the fuel tanks. Since collisions occur infrequently, the potential impacts to offshore water quality are not expected to be significant.

Summary and Conclusion

Accidental events associated with the WPA proposed action that could impact coastal water quality include spills of oil and refined hydrocarbons, releases of natural gas and condensate, spills of chemicals or drilling fluids. The loss of well control, pipeline failures, collisions, or other malfunctions could also result in such spills. Although response efforts may decrease the amount of oil in the environment, the response efforts may also impact the environment through, for example, increased vessel traffic, hydromodification, and application of dispersants. Natural degradation processes would also decrease the amount of spilled oil over time. For coastal spills, two additional factors that must be considered are the shallowness of the area the spill is in and the proximity of the spill to shore. Over time, natural processes can physically, chemically, and biologically degrade oil. Chemicals used in the oil and gas industry are not a significant risk in the event of a spill because they are either nontoxic, used in minor quantities, or are only used on a noncontinuous basis. Spills from collisions are not expected to be significant because collisions occur infrequently.

4.1.1.2.1.4. Cumulative Impacts

A detailed description of cumulative impacts on water quality can be found in Chapter 4.5.2 of the Multisale EIS and in Chapter 4.1.2.1.4 of the 2009-2012 Supplemental EIS.

Activities in the cumulative scenario that could impact coastal water quality generally include the broad categories of the proposed action and the OCS Program, State oil and gas activity, the activities of other Federal agencies (including the military), natural events or processes, and activities related to the direct or indirect use of land and waterways by the human population (e.g., urbanization, agricultural practices, coastal industry, and municipal wastes). Many of these categories would have some of the same specific impacts (e.g., vessel traffic would occur for all of these categories except natural processes).

Sediment disturbance and turbidity may result from nearshore pipeline installation, maintenance dredging, disposal of dredge materials, sand borrowing, sediment deposition from rivers, and hurricanes. Turbidity is also influenced by the season. These impacts may be the result of Gulfwide OCS-related activities, State oil and gas activities, the activities of other Federal agencies, and natural processes. Dredging projects related to restoration or flood prevention measures may be directed by the Federal Government for the benefit of growing coastal populations. Chapter 4.1.2.1.7 of the Multisale EIS notes that COE and State permits would require that the turbidity impacts due to pipeline installation be mitigated by using turbidity screens and other turbidity reduction or confinement equipment. These impacts generally degrade water quality locally and are not expected to last for long periods of time.

Vessel discharges can degrade water quality. Vessels may be service vessels supporting the proposed action, OCS-related activities, or State oil and gas activities. However, the vessels may also be vessels used for shipping, fishing, military activities, or recreational boating. Fortunately, for many types of vessels, most discharges are treated or otherwise managed prior to release through regulations administered by USCG and/or USEPA, and many regulations are becoming more stringent. For example, the USCG Ballast Water Management Program, which was designed to prevent the introduction of invasive species, became mandatory for some vessels in 2004 (33 CFR 151 Subparts C and D) (U.S. Dept. of Homeland Security, CG, 2010b). Furthermore, USCG published the Ballast Water Discharge Standard Notice of Proposed Rulemaking in the *Federal Register* on August 28, 2009. Additionally, the final Vessel General Permit, issued by USEPA, became effective on December 19, 2008. This permit is in addition to already existing NPDES permit requirements and now increases the NPDES regulations so that discharges incidental to the normal operation of vessels operating as a means of transportation are no longer excluded unless exempted from NPDES permitting by Congressional legislation (USEPA, 2008b). These regulations should minimize the cumulative impacts of vessel activities.

Erosion and runoff from nonpoint sources degrade water quality. Nonpoint-source runoff from onshore support facilities could result from OCS-related activities as well as State oil and gas activities and other industries and coastal development. The leading source of contaminants that impair coastal water quality is urban runoff. Urban runoff can include suspended solids, heavy metals and pesticides, oil and grease, and nutrients. Urban runoff increases with population growth, and the Gulf Coast region has experienced a 103 percent population growth since 1970 (USDOC, NOAA, 2008a). The natural emptying of rivers into the GOM as part of the water cycle may introduce chemical and physical factors that alter the condition of the natural water through both natural and anthropogenic sources, such as the addition of waterborne pollutants, or the addition of warmer water, into the GOM through waterbodies emptying into the GOM, runoff, groundwater discharge, or precipitation. Nutrients carried in waters of the Louisiana and Texas rivers contribute to seasonal formation of hypoxic zones on the Louisiana and Texas shelf. Chapter 4.5.2.1 of the Multisale EIS summarizes USEPA's regulatory programs designed to protect the waters that enter the Gulf. If these and other water quality programs and regulations continue to be administered and enforced, it is not expected that additional oil and gas activities would adversely impact the overall water quality of the region.

Water quality in coastal waters of the northern Gulf of Mexico is also highly influenced by season. Seasonality influences salinity and dissolved oxygen, nutrient content, temperature, pH and Eh, pathogens, turbidity, metals, and organic compounds.

Since the marine environment is a dynamic system, sediment quality and water quality can affect each other. For example, a contaminant may react with the mineral particles in the sediment and be removed from the water column (e.g., adsorption). Thus, under appropriate conditions, sediments can serve as sinks for contaminants such as metals, nutrients, or organic compounds. However, if sediments are (re)suspended (e.g., due to dredging or a storm event), the resuspension can lead to a temporary redox flux, including a localized and temporal release of any formally sorbed metals as well as nutrient recycling (Caetano et al., 2003; Fanning et al., 1982).

Accidental releases of oil, gas, or chemicals would degrade water quality during and after the spill, until either the spill is cleaned up or natural processes degrade or disperse the spill. These accidental releases could be a result of the proposed action, ongoing OCS activity, State oil and gas activity, the transport of commodities to ports, and/or coastal industries. The impacts of rare, catastrophic spills are discussed in **Appendix B**. A catastrophic event would not be expected to occur in coastal waters, but a catastrophic spill in offshore waters could affect coastal waters. The extent of impact from a spill depends on the behavior and fate of oil in the water column (e.g., the movement of oil and the rate and nature of weathering), which, in turn, depends on oceanographic and meteorological conditions at the time (Appendices A.2 and A.3 of the Multisale EIS). Chapter 4.5.2.1 of the Multisale EIS contains more information on accidental releases. A major hurricane can result in a greater number of coastal oil and chemical spill events, with increased spill volume and decreases in oil-spill-response times. In the case of an accidental event, it is likely that response efforts would reduce the amount of oil. See **Chapter 3.2.1.5** for further discussion of oil-spill-response considerations. Coastal water quality would not only be impacted by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts. Increased vessel traffic, hydromodification (e.g., dredging, berm building, etc.), and the addition of dispersants and methanol to the marine environment in an effort to contain, mitigate, or clean up the oil may also tax the environment to some degree.

Summary and Conclusion

Water quality in coastal waters would be impacted by sediment disturbance and suspension (i.e., turbidity), vessel discharges, erosion, and runoff from nonpoint-source pollutants including river inflows, seasonal influences, and accidental events. These impacts may be a result of the proposed action and the OCS Program, State oil and gas activity, the activities of other Federal agencies (including the military), natural events or processes, or activities related to the direct or indirect use of land and waterways by the human population (e.g., urbanization, agricultural practices, coastal industry, and municipal wastes). The impacts resulting from the WPA proposed action are a small addition to the cumulative impacts on the coastal waters of the Gulf because non-OCS activities, including vessel traffic, erosion, and nonpoint source runoff, are cumulatively responsible for a majority of coastal water impacts. Increased turbidity and discharge from the WPA proposed action would be temporary in nature and minimized by regulations and mitigation. Since a catastrophic OCS Program-related accident would be both rare and not expected to occur in coastal waters, the impact of accidental spills is expected to be small. The incremental contribution of the routine activities and accidental events associated with the proposed action to the cumulative impacts on coastal water quality is not expected to be significant.

4.1.1.2.2. Offshore Waters

4.1.1.2.2.1. Description of the Affected Environment

A detailed description of offshore water quality can be found in Chapter 3.1.2.2 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the

Multisale EIS is presented in Chapter 4.1.2.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The Gulf of Mexico is the ninth largest waterbody in the world (USDOC, NOAA, 2008a). Over 150 rivers empty out of North America into the Gulf of Mexico (Gore, 1992, p. 127). The rivers emptying into the Gulf bring freshwater and sediment into coastal waters (Gore, 1992, pp. 127-131), which affects the water quality of these waters. Rivers carry excess nutrients (e.g., nitrogen and phosphorus), as well as other possible inputs such as contaminants from industrial wastewater discharge, downstream; and this effect is cumulative as the river reaches an estuary (Gore, 1992, pp. 280 and 291). The emptying of rivers into the GOM is part of the hydrologic cycle or water cycle (USDOI, GS, 2010a); understanding this cycle not only explains the movement of water on Earth but also how water quality might be affected by both natural and anthropogenic sources. The water cycle may introduce components into the GOM through waterbodies emptying into the GOM, runoff, groundwater discharge, or precipitation. Water quality can be affected by not only chemical processes but also by physical and biological processes. For example, the water quality of the Gulf of Mexico is influenced by the physical oceanography of the Gulf of Mexico, which is described in Appendix A.2 of the Multisale EIS. Besides nutrients, water quality is generally gauged by measuring a series of parameters commonly including, but not limited to, temperature, salinity, dissolved oxygen, pH, Eh, pathogens, and turbidity. Water quality may also examine possible pollutants such as metals and organic compounds.

The water offshore of the Gulf's coasts can be divided into two regions: shallow (<1,000 ft; 305 m) and deep water (>1,000 ft; 305 m). Waters on the continental shelf (0-200 m; 0-656 ft) and slope (200-2,000 m; 656-6,562 ft) are heavily influenced by the Mississippi and Atchafalaya Rivers, the primary sources of freshwater, sediment, nutrients, and pollutants from a huge drainage basin encompassing 55 percent of the continental U.S. (Murray, 1998). The presence or extent of a nepheloid layer, a body of suspended sediment at the sea bottom (Kennet, 1982, p. 524), affects water quality on the shelf and slope. Deep waters east of the Mississippi River are affected by the Loop Current and associated warm-core (anticyclonic) eddies, which consist of clear, low-nutrient water (Muller-Karger et al., 2001). However, cold-core cyclonic eddies (counterclockwise rotating) also form at the edge of the Loop Current and are associated with upwelling and nutrient-rich, high-productivity waters. More details on the physical oceanography of the Gulf of Mexico are available in Appendix A.2 of the Multisale EIS and in **Chapter 3.3.7.1** of this Supplemental EIS.

Seawater generally averages pH 8 at the surface due to marine systems being buffered by carbonates and bicarbonates; however, in the open waters of the Gulf of Mexico, pH ranges from approximately 8.1 to 8.3 at the surface (Gore, 1992, p. 87). The pH decreases to approximately 7.9 at a depth of 700 m (2,297 ft), and in deeper waters, it increases again to approximately 8.0 (Gore, 1992, p. 87).

The salinity in the Gulf of Mexico is generally 36 parts per thousand (ppt) (Gore, 1992, p. 87). Lower salinities are characteristic nearshore where freshwater from the rivers mix with Gulf waters. For example, salinity can decrease to less than 25 ppt near inlets due to the emptying of rivers (runoff) (Gore, 1992, p. 81). Salinity also varies seasonally. For example, salinity in open water near the coast may vary between 29 and 32 practical salinity units (psu) during fall and winter but decline to 20 psu during spring and summer due to increased runoff (USDOI, MMS, 2000) (practical salinity units [psu] are similar to parts per thousand [ppt] but not identical).

Temperatures in the Gulf of Mexico vary seasonally. The average summer surface temperature is approximately 29 ºC (84 ºF) (Gore, 1992, p. 79). In winter, temperature in the northern Gulf is 19 ºC (65 ºF) and in the southern portion of the Gulf, it is about 24 ºC (75 ºF) (Gore, 1992, p. 79). However, temperatures may dip lower during cold fronts. In winter, seawater is well mixed (Gore, 1992, p. 80). At other times, sea-surface temperatures can vary from temperatures at depth. In the summer, warm water may be found from the surface down to a certain depth known at the thermocline; below this depth, the temperature becomes cooler and, therefore, the water becomes denser (Gore, 1992, pp. 79-80). In the Gulf, the thermocline may be found anywhere from just below the surface to 160 ft (50 m) deep. Seawater also gets colder in deep water. Below 1,000 m (about 3,300 ft), temperatures are the coldest in the Gulf at <4.4 ºC (40 ºF).

Dissolved oxygen enters the upper waters (~100-200 m; 328-656 ft) of Gulf of Mexico through the atmosphere and phytosynthesis (Jochens et al., 2005). In deep waters, dissolved oxygen is introduced through the transport and mixing of oxygen-rich watermasses into the Gulf of Mexico from the Caribbean Sea through the Yucatan Channel (Jochens et al., 2005). The Gulf of Mexico does not have watermass formation to replenish the deep oxygen concentrations (Jochens et al., 2005). Thus, the deep circulation of the Gulf of Mexico and its related mixing are the mechanisms that replenish the deep oxygen (Jochens et al., 2005). Oxidation of organic matter is the major oxygen sink in the Gulf of Mexico (Jochens et al., 2005). The Gulf of Mexico has an oxygen minimum zone, which is generally located from 300 to 700 m (984 to 2,297 ft) (Jochens et al., 2005).

The zone of hypoxia on the Louisiana-Texas shelf occurs seasonally and is affected by the timing of the Mississippi and Atchafalaya Rivers' discharges carrying nutrients to the surface waters. The hypoxic conditions last until local wind-driven circulation mixes the water again. The 2010 GOM dead zone covered 20,000 km^2 (7,722 mi^2) (LUMCON, 2010a). Nutrients from the Mississippi River fueling enhanced phytoplankton is what was attributed to the formation of the hypoxic zone. The 2010 dead zone was reported to be one of the largest ever. The area reported in 2009 measured 8,000 km^2 (3,000 mi^2) (LUMCON, 2009), while the area reported in 2008 measured 20,720 km^2 (8,000 mi^2) (LUMCON, 2008).

Separate zones of hypoxia have been discovered 5-15 mi (8-24 km) off the coast of Texas and are likely the result of freshwater inputs generated in Texas and summer upwelling. In 2007, a Texas-created dead zone was discovered and attributed to excessive rainfall and runoff into the Brazos River (LUMCON, 2010b).

The priority, water quality issues identified by the Gulf of Mexico Alliance are (1) reducing risk of exposure to disease-causing pathogens, (2) minimizing occurrence and effects of harmful algal blooms, (3) identifying sources of mercury in Gulf seafood, and (4) improving the monitoring of Gulf water resources (Gulf of Mexico Alliance, 2009a). In addition to water quality itself, nutrients and nutrient impacts are also a regional priority issue for the organization (Gulf of Mexico Alliance, 2009b).

As noted above, coastal waters are greatly affected by runoff. Runoff may include any number of pollutants such as nutrients, pesticides and other organic chemicals, and metals. Shallow water on the shelf and slope are also affected by runoff. The National Research Council (2003, Table I-4, p. 237) estimated that, on average, approximately 26,324 bbl of oil per year entered Gulf waters from petrochemical and oil refinery industries in Louisiana and Texas. The Mississippi River introduced approximately 3,680,938 bbl of oil and grease per year from land-based sources (NRC, 2003, Table I-9, p. 242) into the waters of the Gulf of Mexico. Offshore waters, especially deeper waters, are more directly affected by natural seeps since the natural seeps in the Gulf of Mexico are located in offshore waters. Hydrocarbons enter the Gulf of Mexico through natural seeps in the Gulf of Mexico at a rate of approximately 980,392 bbl per year (a range of approximately 560,224-1,400,560 bbl per year) (NRC, 2003, p. 191). Hydrocarbons from natural seeps are considered to be the highest contributor of petroleum hydrocarbons to the marine environment (NRC, 2003, p. 33). Produced water (formation water) is the largest waste stream by volume from the oil and gas industry that enters Gulf waters. Produced water is commonly treated to separate free oil and is either injected back into the reservoir or discharged overboard according to NPDES permit limits. The NRC has estimated the quantity of produced water entering the Gulf per year to be 473,000 bbl (NRC, 2003, p. 200, Table D-8).

Since the marine environment is a dynamic system, sediment quality and water quality can affect each other. For example, a contaminant may react with the mineral particles in the sediment and be removed from the water column (e.g., adsorption). Thus, under appropriate conditions, sediments can serve as sinks for contaminants such as metals, nutrients, or organic compounds. However, if sediments are (re)suspended (e.g., due to dredging or a storm event), the resuspension can lead to a temporary redox flux, including a localized and temporal release of any formally sorbed metals as well as nutrient recycling (Caetano et al., 2003; Fanning et al., 1982). However, resuspension events are less likely in deepwater environments. Deepwater sediments, with the exception of barium concentrations in the vicinity of previous drilling, do not appear to contain elevated levels of metal contaminants (USDOI, MMS, 1997 and 2000). The western Gulf has lower levels of total organic carbon and hydrocarbons in sediment, particularly those from terrestrial sources, than the central Gulf (Gallaway and Kennicutt, 1988). Reported total hydrocarbons, including biogenic (e.g., from biological sources) hydrocarbons, in sediments collected from the Gulf slope range from 5 to 86 nanograms/gram (Kennicutt et al., 1987). Hydrocarbons in sediments have been determined to influence biological communities of the Gulf slope, even when present in trace amounts (Gallaway and Kennicutt, 1988).

Several studies have addressed offshore water and sediment quality in deep waters. Water at depths >1,400 m (4,593 ft) is relatively homogeneous with respect to temperature, salinity, and oxygen (Nowlin, 1972; Pequegnat, 1983; Gallaway et al., 1988; Jochens et al., 2005). Limited analyses of trace metals and hydrocarbons for the water column and sediments exist (Trefry, 1981; Gallaway and Kennicutt, 1988). Continental Shelf Associates, Inc. (CSA) completed an Agency-funded field study of four drilling sites located in water depths of 1,033-1,125 m (3,389-3,691 ft) (CSA, 2006a). The sampling design called for before and after exploratory or development drilling and captured the drilling-related changes that occur in sediments and sediment pore water. Chemical impacts of drilling were detected at all four sites. Impacts noted within the near-field zone included elevated barium, synthetic-based fluid (SBF), total organic carbon (TOC) concentrations, and low sediment oxygen levels. At the Viosca Knoll Block 916 site, the closest drilling activity had occurred 1.4 mi (2.3 km) north-northwest and 2 years prior to the study; no drilling had ever been performed at the Viosca Knoll Block 916 site. The site was located at a water depth of 1,125 m (3,691 ft) and 70 mi (120 km) from the mouth of the Mississippi River. At this relatively pristine site, mean concentrations of sediment barium increased by ~30-fold at near-field stations following exploratory drilling (from 0.108% to 3.32%). As well, mean concentrations of sediment mercury and total PAH increased in the near-field from 71 to 90 nanograms/gram and from 232 to 279 nanograms/gram. At this site, sediment cadmium concentrations did not change significantly following exploratory drilling.

The condition of offshore waters of the Gulf of Mexico was altered by the DWH event and associated oil spill. The Government estimated that approximately 4.9 million barrels of oil were released during the event (Oil Spill Commission, 2011c) and that approximately 1.84 million gallons of dispersant were used to breakup and dilute the oil subsea at the wellhead and on the surface (Oil Spill Commission, 2011d). As well, the corresponding emission of methane from the wellhead during the DWH event was estimated between 9.14×10^9 and 1.25×10^{10} moles (Kessler et al., 2011). In shelf waters, surface water oiling stretched from a maximum westward extent at roughly the Louisiana-Texas border to an eastward extent around Apalachicola, Florida (Oil Spill Commission, 2011c, Figure 7.1). Surface oiling was also observed stretching southward from the spill site, farther over deep waters, as oil was advected by cyclones at the northern edge of the Loop Current (e.g., USDOC, NOAA, 2010b). As well, a subsurface oil and gas plume was discovered in deep waters between ~1,100 and 1,300 m (3,609 and 4,265 ft) (e.g., Diercks et al., 2010). Based on in-situ fluorescence and oxygen measurements (proxies for oil concentration and biodegradation, respectively), the subsurface plume traveled to the northeast of the wellhead and much farther to the southwest, reaching as far west as approximately -93.0° (e.g., Kessler et al., 2011). Thus, based on these observations, few (if any) offshore water quality impacts have been documented on the WPA itself by the DWH event.

Offshore water quality will not only be impacted by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts. Increased vessel traffic, hydromodification and the addition of dispersants, methanol, and water-based drilling mud to the marine environment in an effort to contain, mitigate, or clean up the oil may also tax the environment to some degree. Fortunately, over time, natural processes can physically, chemically, and biologically degrade oil (NRC, 2003). The physical processes involved include evaporation, emulsification, and dissolution; the primary chemical and biological degradation processes include photooxidation and biodegradation (i.e., microbial oxidation).

4.1.1.2.2.2. Impacts of Routine Events

Background/Introduction

A detailed description of routine impacts on offshore water quality can be found in Chapter 4.2.1.1.2.2 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.2.2.2 of the 2009-2012 Supplemental EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

The routine activities associated with the WPA proposed action that would impact water quality include the following:

- discharges during drilling of exploration and development wells;
- structure installation and removal;
- discharges during production;
- installation of pipelines;
- workovers of wells,
- maintenance dredging of existing navigational canals;
- service vessel discharges; and
- nonpoint-source runoff.

The scenario information related to the WPA proposed action is presented in **Table 3-2**.

The USEPA regulates discharges associated with offshore oil and gas exploration, development, and production activities on the OCS under the Clean Water Act's NPDES program. Regulated wastes include drilling fluids, drill cuttings, deck drainage, produced water, produced sand, well treatment fluids, well completion fluids, well workover fluids, sanitary wastes, domestic wastes, and miscellaneous wastes (USEPA, 2009). The U.S. Environmental Protection Agency's NPDES general permit for Region 6 (GMG290000, which authorizes discharges to surface water during drilling and production) was reissued and went into effect on October 1, 2007 (USEPA, 2007c). This permit covers the WPA. The permit will expire on September 30, 2012.

The bulk of waste materials produced by offshore oil and gas activities are formation water (produced water) and drilling muds and cuttings. All of these waste streams are regulated by USEPA through NPDES permits. Characteristics of drilling muds and cuttings, the impacts of discharge, and regulatory controls are discussed in great detail in Chapter 4.1.1.4.1 of the Multisale EIS. The WPA proposed action is projected to result in the drilling of a total of 40-66 exploratory and delineation wells and 137-221 development and production wells (**Table 3-2**). Muds are the weighted fluids used to lubricate the drill bit, and cuttings are the ground rock displaced from the well. Drilling muds generally consist of clays, barite, lignite, caustic soda (sodium hydroxide), lignosulfonates, and a base fluid such as freshwater, saltwater, mineral oil, diesel oil, or a synthetic oil (USDOI, BOEMRE, 2010h; NRC, 1983; USEPA, 2009); however, the exact formulas are complex and vary. Three general types of drilling muds have been used during drilling operations: water-based drilling muds (WBM or WBF), oil-based drilling muds (OBM or OBF), and synthetic-based drilling muds (SBM or SBF). The WBM and WBM-wetted cuttings may be discharged. The OBM's are used to improve drilling through difficult geologic formations. The base mud for OBM is typically diesel or mineral oil. Because these oils often contain toxic materials such as PAH's, the discharge of OBM or cuttings wetted with OBM is prohibited. The SBM's were developed as an alternative to OBM. The base fluid is a synthetic material, typically an olefin or ester, free of toxic PAH's. Discharge of SBM is prohibited and, due to cost, is generally recycled (USEPA, 2009). However, SBM-wetted cuttings may be discharged after the majority of the SBM has been removed. Water-based muds and cuttings that are discharged increase turbidity in the water column and alter the sediment characteristics in the area where they settle (Neff, 2005). The SBF-wetted cuttings do not disperse as readily in water and descend in clumps to the seafloor (Neff et al., 2000). The SBF on the wetted cuttings gradually breaks down and may deplete the oxygen level at the sediment water interface as it degrades (Neff et al., 2000).

During production, produced water is brought up from the hydrocarbon-bearing strata along with the oil and gas that is generated. Characteristics of produced water, the impacts of discharge, and regulatory controls are discussed in greater detail in Chapter 4.1.1.4.2 of the Multisale EIS. The scenario for the WPA projects that 137-221 development and production wells would be drilled, of which 39-65 are expected to be producing oil wells and 83-127 are expected to be producing gas wells (**Table 3-2**).

Greater volumes of produced water are associated with oil rather than with gas production; in fact, a report on produced-water volumes in the United States noted that 87 percent of produced water came from oil production (Clark and Veil, 2009). Produced water may contain dissolved solids in higher concentrations than Gulf waters, metals, hydrocarbons, and naturally-occurring radionuclides (Veil et al., 2004). Produced water may contain residuals from the treatment completion or workover compounds used, as well as additives used in the oil/water separation process (Veil et al., 2004). Produced water is treated to meet NPDES requirements before it is discharged.

Additional chemical products are used to "workover" or treat a well. These wastes are regulated by USEPA through the NPDES program as noted above. Characteristics of workover treatment and production chemicals, the impacts of discharge, and regulatory controls are discussed in greater detail in Chapter 4.1.1.4.3 of the Multisale EIS. Some examples of chemicals that might be used to "workover" or treat a well include, but are not limited to, brines used to protect a well, acids used to increase well production, and miscellaneous products used to separate water from oil, to prevent bacterial growth, or to eliminate scale formation or foaming (Boehm et al., 2001).

During structure installation and removal, impacts from anchoring, mooring, pipeline and flowline emplacement, and the placement of subsea production structures may occur. The WPA proposed action is projected to result in the installation of 26-41 structures and the removal of 19-33 structures (**Table 3-2**). The WPA proposed action is also projected to result in the installation of 130-760 km (~81-472 mi) of pipeline. Additional information on bottom-area disturbance is available in Chapter 4.1.1.3.2.1 of the Multisale EIS. More specifically, a description of the pipeline installation is provided in Chapter 4.1.1.8.1 of the Multisale EIS. In the report titled *Brief Overview of Gulf of Mexico OCS Oil and Gas Pipelines: Installation, Potential Impacts, and Mitigation Measures* (Cranswick, 2001), the following is stated:

> According to MMS regulations (30 CFR 250.1003(a)(1)), pipelines with diameters ≥8 5/8 inches that are installed in water depths <200 ft are to be buried to a depth of at least 3 ft below the mudline. The regulations also provide for the burial of any pipeline, regardless of size, if the MMS determines that the pipeline may constitute a hazard to other uses of the OCS; in the GOM, the MMS has determined that all pipelines installed in water depths <200 ft must be buried. The purpose of these requirements is to reduce the movement of pipelines by high currents and storms, to protect the pipeline from the external damage that could result from anchors and fishing gear, to reduce the risk of fishing gear becoming snagged, and to minimize interference with the operations of other users of the OCS. For lines 8 5/8 inches and smaller, a waiver of the burial requirement may be requested and may be approved if the line is to be laid in an area where the character of the seafloor would allow the weight of the line to cause it to sink into the sediments (self-burial). For water depths ≤200 ft, any length of pipeline that crosses a fairway or anchorage in Federal waters must be buried to a minimum depth of 10 ft below mudline across a fairway and a minimum depth of 16 ft below mudline across an anchorage area. Some operators voluntarily bury these pipelines deeper than the minimum.

Any disturbance of the seafloor would increase turbidity in the surrounding water, but the increased turbidity should be temporary and restricted to the area near the disturbance.

Service-vessel discharges include bilge and ballast water and sanitary and domestic waste. The WPA proposed action is projected to result in 76,000-141,000 service-vessel round trips (**Table 3-2**). A marine sanitation device is required to treat sanitary waste generated on the service vessel so that surrounding water would not be impacted by possible bacteria or viruses in the waste (40 CFR 140 and 33 CFR 159). The discharge of treated sanitary waste would still contribute a small amount of nutrients to the water. A description of service-vessel operational wastes is provided in Chapter 4.1.1.4.8 of the Multisale EIS. Oil may contaminate bilge and, though less likely, ballast water. The regulations for the control of oil discharges are in 33 CFR 151.10 and state that bilge and ballast water may only be discharged with an oil content of less than 15 ppm. The discharges would affect the water quality locally. However, regulations regarding discharges from vessels are becoming increasingly stringent. The USCG Ballast Water

Management Program became mandatory for some vessels in 2004 (33 CFR 151 Subparts C and D) (U.S. Dept. of Homeland Security, CG, 2010b).

The program was designed to prevent the introduction on nonindigenous (invasive) species, which would affect local water quality. Furthermore, USCG published the Ballast Water Discharge Standard Notice of Proposed Rulemaking in the *Federal Register* on August 28, 2009 (*Federal Register*, 2009c). Additionally, the final Vessel General Permit, issued by USEPA, became effective on December 19, 2008. This permit is in addition to already existing NPDES permit requirements and now increases the NPDES regulations so that discharges incidental to the normal operation of vessels operating as a means of transportation are no longer excluded unless exempted from NPDES permitting by Congressional legislation (USEPA, 2008a).

Summary and Conclusion

During exploratory activities, the primary impacting sources to offshore water quality are discharges of drilling fluids and cuttings. During platform installation and removal activities, the primary impacting sources to water quality are sediment disturbance and temporarily increased turbidity. Impacting discharges during production activities are produced water and supply-vessel discharges. Regulations are in place to limit the levels of contaminants in these discharges. Pipeline installation can also affect water quality by sediment disturbance and increased turbidity. Service-vessel discharges might include water with oil concentration of approximately 15 ppm, as established by regulatory standards. Any disturbance of the seafloor would increase turbidity in the surrounding water, but the increased turbidity should be temporary and restricted to the area near the disturbance. There are multiple Federal regulations and permit requirements that would decrease the magnitude of these activities. Impacts to offshore waters from routine activities associated with the WPA proposed action should be minimal as long as regulatory requirements are followed.

4.1.1.2.2.3. Impacts of Accidental Events

Background/Introduction

A detailed description of accidental events on offshore water quality can be found in Chapter 4.4.2.2 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.2.2.3 of the 2009-2012 Supplemental EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Accidental events associated with the WPA proposed action that could impact offshore water quality include spills of oil and refined hydrocarbons, releases of natural gas, spills of chemicals or drilling fluids, and loss of well control, collisions, or other malfunctions that would result in such spills. **Chapter 3.2** discusses the accidental events that could result from the impact-producing factors and scenario, with particular attention given to the risk of oil spills, response to such oil spills, loss of well control, pipeline failures, vessel collisions, and chemical and drilling fluid spills. A brief summary is presented here. The impacts of rare, catastrophic spills are discussed in **Appendix B**.

Proposed Action Analysis

Oil Spills and Natural Gas and Condensate Releases

Water quality is altered and degraded by oil spills through the increase of petroleum hydrocarbons and their various transformation/degradation products in the water. The extent of impact from a spill depends on the behavior and fate of oil in the water column (e.g., the movement of oil and the rate and nature of weathering), which, in turn, depends on oceanographic and meteorological conditions at the time (Appendices A.2 and A.3 of the Multisale EIS). Crude oils are not a single chemical, but instead are complex mixtures with varied compositions. The various fractions within the crude behave differently in water; thus, the behavior of the oil and the risk that the oil poses to natural resources depends on the composition of the specific oil encountered (Michel, 1992). Generally, oils can be divided into three groups of compounds: (1) light-weight; (2) medium-weight; and (3) heavy-weight components. **Chapter**

3.2.1 further characterizes the components of oil and discusses oil spills. Most of the oil spills that may occur as a result of the proposed action are expected to be ≤1 bbl (**Table 3-7**). Chapter 4.3.1 of the Multisale EIS also discusses oil spills in further detail, with Chapter 4.3.1.4 of the Multisale EIS describing the characteristics of OCS oil. Generally, the lighter ends of the oil are more water soluble and would contribute to acute toxicity. As the spill weathers, the aromatic components at the water's surface are more likely to exit the water. The heavier fractions are less water soluble and would partition to organic matter. This fraction is more likely to persist in sediments and would contribute to longer-term impacts.

In addition to oil, natural gas may also be explored for or produced in the GOM. Wells and sidetracks may produce a mixture of both oil and natural gas. Condensate is a liquid hydrocarbon phase that generally occurs in association with natural gas. The quality and quantity of components in natural gas vary widely by the field, reservoir, or location from which the natural gas is produced. Although there is not a "typical" makeup of natural gas, it is primarily composed of methane (NaturalGas.org, 2010b). Thus, if natural gas were to leak into the environment, methane may be released to the environment. Methane is a carbon source, such as oil, and its introduction into the marine environment could result in lowering dissolved oxygen levels due to increased microbial degradation. Unfortunately, little is known about the toxicity of natural gas and its components in the marine environment, but there is concern as to how methane in the water column might affect fish (**Chapter 4.1.1.13**).

Hydrogen sulfide (H_2S), a toxic gas that is associated with certain formations in the GOM, could be released with natural gas. Depending on the concentration and volume, an H_2S release at the seafloor could negatively impact the water quality as the gas rises to the surface (Patin, 1999).

The National Academy of Sciences (NRC, 2003), Patin (1999), and Boesch and Rabalais (1987) have reviewed the fate and effects of spilled oil and, to a lesser degree, natural gas releases. Chapters 4.3.1.5 and 4.3.1.6 of the Multisale EIS present the risk of offshore spills associated with the proposed action, and **Chapters 3.2.1.1 and 3.2.1.2** of this Supplemental EIS supplement and update that information. Oil spills at the water surface may result from a platform accident. Subsurface spills are more likely to occur from pipeline failure or a loss of well control. As noted above, the behavior of a spill depends on many things, including the characteristics of the oil being spilled as well as oceanographic and meteorological conditions. An experiment in the North Sea indicated that the majority of oil released during a deepwater blowout would quickly rise to the surface and form a slick (Johansen et al., 2001). In such a case, impacts from a deepwater oil spill would occur at the surface where the oil is likely to be mixed into the water and dispersed by wind and waves. The oil would undergo natural physical, chemical, and biological degradation processes including weathering. However, data and observations from the DWH event challenged the previously prevailing thought that most oil from a deepwater blowout would quickly rise to the surface. While analyses are in their preliminary stages, it appears that measurable amounts of hydrocarbons (dispersed or otherwise) are being detected in the water column as subsurface plumes and perhaps on the seafloor in the vicinity of the release. After the *Ixtoc* blowout in 1979, which was located 50 mi (80 km) offshore in the Bay of Campeche, Mexico, some subsurface oil also was observed dispersed within the water column (Boehm and Fiest, 1982); however, the scientific investigations were limited (Reible, 2010). The water quality of offshore waters would be affected by the dissolved components and oil droplets that are small enough that they do not rise to the surface or are mixed down by surface turbulence. In the case of subsurface oil plumes, it is important to remember that these plumes would be affected by subsurface currents and could be diluted over time. Even in the subsurface, oil would undergo natural physical, chemical, and biological degradation processes including weathering.

In the case of an accidental event, it is likely that response efforts would reduce the amount of oil in the environment. **Chapter 3.2.1.5** provides a further discussion of oil-spill-response considerations. Offshore water quality would not only be impacted by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts. Increased vessel traffic, top kill attempts involving the use of drilling muds, and the addition of dispersants and methanol to the marine environment in an effort to contain, mitigate, or clean up the oil may also tax the environment to some degree.

Top kills use drilling muds, which are heavy due to the mineral component barite, in order to stop flow from a well. Top kill methods would likely involve the use of water-based drilling muds, which may be discharged to the ocean under normal operations as regulated by USEPA (USDOI, BOEMRE, 2010h). Depending on the success of the procedure, a portion of the mud could end up on the seafloor since drilling mud discharges do not move far from where they are released (CSA, 2006a). See "Accidental Release of Drilling Fluids" below for more information.

One standard tool used in response to spilled oil on water is dispersants. The purpose of chemical dispersants is to facilitate the movement of oil into the water column in order to encourage weathering and biological breakdown of the oil (i.e., biodegradation) (NRC, 2005; Australian Maritime Safety Authority, 2010). If the oil moves into the water column and is not on the surface of the water, it is less likely to reach sensitive shore areas (USEPA, 2010e). The toxicity of dispersed oil in the environment would depend on many factors, including the effectiveness of the dispersion, temperature, salinity, the degree of weathering, type of dispersant, and the degree of light penetration in the water column (NRC, 2005). The toxicity of dispersed oil is primarily due to the toxic components of the oil itself (Australian Maritime Safety Authority, 2010).

In addition to response efforts, the natural environment can attenuate some oil. The Gulf of Mexico has numerous natural hydrocarbon seeps, as discussed in Chapters 3.1.2.2 and 4.1.3.4.1 of the Multisale EIS. Thus, the marine environment can be considered adapted to handling small amounts of oil released over time. Furthermore, over time, natural processes can physically, chemically, and biologically degrade oil (NRC, 2003). The physical processes involved include evaporation, emulsification, and dissolution; the primary chemical and biological degradation processes include photooxidation and biodegradation (i.e., microbial oxidation).

Chemical Spills

A study of chemical spills from OCS activities determined that accidental releases of zinc bromide and ammonium chloride could potentially impact the marine environment (Boehm et al., 2001). Both of these chemicals are used for well treatment or completion and are not in continuous use; thus, the risk of a spill is small. Most other chemicals are either relatively nontoxic or used in such small quantities that a spill would not result in measurable impacts. Zinc bromide is of particular concern because of the toxic nature of zinc. Close to the release point of an ammonium chloride spill, the ammonia concentrations could exceed toxic levels.

Accidental Releases of Drilling Fluids

Drilling muds or fluids are the weighted fluids used to lubricate the drill bit. Drilling muds generally consist of clays, barite, lignite, caustic soda (sodium hydroxide), lignosulfonates, and a base fluid such as freshwater, saltwater, mineral oil, diesel oil, or a synthetic oil (USDOI, BOEMRE, 2010h; NRC, 1983; USEPA, 2009); however, the exact formulas are complex and vary. The impacts of discharge and regulatory controls of drilling muds are discussed in great detail in Chapter 4.1.1.4.1 of the Multisale EIS. Three general types of drilling muds have been used during drilling operations: water-based drilling muds (WBM or WBF); oil-based drilling muds (OBM or OBF); and synthetic-based drilling muds (SBM or SBF). Accidental releases of drilling fluids would have similar effects as discharges. In general, Continental Shelf Associates, Inc.'s research has shown that drilling mud discharges do not move very far, even when discharged at the surface (CSA, 2006a); therefore, accidental releases of drilling muds are not expected to move very far either. The WBM may be discharged, but those discharges are regulated by USEPA through NPDES permits. Water-based muds that are discharged increase turbidity in the water column and alter the sediment characteristics in the area where they settle (Neff, 2005). The OBM's are used to improve drilling through difficult geologic formations. The base mud for OBM is typically diesel or mineral oil. Because these oils often contain toxic materials such as PAH's, the discharge of OBM or cuttings wetted with OBM is prohibited. Thus, an accidental release of OBM's could decrease water quality locally. The SBM's were developed as an alternative to OBM and, thus, the use of OBM's has been decreasing. The base fluid is a synthetic material, typically an olefin or ester, free of toxic PAH's. Discharge of SBM itself is prohibited and, due to cost, is generally recycled (USEPA, 2009). However, SBM-wetted cuttings may be discharged after the majority of the SBM has been removed. The SBF-wetted cuttings do not disperse as readily in water and descend in clumps to the seafloor (Neff et al., 2000). The SBF on the wetted cuttings gradually breaks down and may deplete the oxygen level at the sediment water interface as it degrades (Neff et al., 2000). An accidental release of SBF is expected to behave similarly with the SBF sinking to the seafloor adjacent to the release site and resulting in local anoxic conditions.

Pipeline Failures

A pipeline failure would result in the release of crude oil, condensate, or natural gas; the impacts of which are discussed above. Pipeline failures are discussed in more detail in **Chapter 3.2.3**.

Fuel Oil Spills from Collisions

A collision may result in the spillage of crude oil, refined products such as diesel, or chemicals. Crude oil and chemicals are discussed in the preceding paragraphs. Diesel is the type of refined hydrocarbon spilled most frequently as the result of a collision. Minimal impacts result from a spill since diesel is light and would evaporate and biodegrade within a few days (USDOC, NOAA, 2006). A collision could result in the release of up to the entire contents of the fuel tanks. Since collisions occur infrequently (USDOI, BOEMRE, 2010i), the potential impacts to offshore water quality are not expected to be significant.

Loss of Well Control

A loss of well control is the uncontrolled flow of a reservoir fluid that may result in the release of gas, condensate, oil, drilling fluids, sand, or water. The impacts of the release of gas, condensate, oil, and drilling fluids are discussed above. A loss of well control includes events with no surface expression or impact on water quality and events with a release of oil or drilling fluids. A loss of well control event may also result in localized suspension of sediments, thus affecting water quality temporarily. Loss of well control is a broad term that includes very minor well-control incidents up to the most serious well-control incidents (**Appendix B**). Historically, most losses of well control have occurred during development drilling operations, but losses of well control can happen during exploratory drilling, production, well completions, or workover operations. Blowouts are a loss of well subset of more serious incidents, with a greater risk of oil spill or human injury. It is through the loss of well control that the volume and duration of a catastrophic oil spill could occur. Although there is an extremely low probability of a catastrophic spill event, the impacts of such an event on water quality are addressed in **Appendix B**. Overall, since loss of well control events and blowouts are rare events (USDOI, BOEMRE, 2010i) and usually of short duration, potential impacts to offshore water quality are not expected to be significant except in the rare case of a catastrophic event.

Summary and Conclusion

Accidental events associated with the WPA proposed action that could impact offshore water quality include spills of oil and refined hydrocarbons, releases of natural gas and condensate, spills of chemicals or drilling fluids, and loss of well control, pipeline failures, collisions, or other malfunctions that would result in such spills. Spills from collisions are not expected to be significant because collisions occur infrequently. Overall, since loss of well control events and blowouts are rare events, and usually of short duration, potential impacts to offshore water quality are not expected to be significant except in the rare case of a catastrophic event (**Appendix B**). Although response efforts may decrease the amount of oil in the environment, the response efforts may also impact the environment through, for example, increased vessel traffic and application of dispersants. Natural physical, chemical, and biological degradation processes would also decrease the amount of spilled oil over time through dilution, weathering, and degradation of the oil (NRC, 2003). Chemicals used in the oil and gas industry are not a significant risk for a spill because they are either nontoxic, used in minor quantities, or are only used on a noncontinuous basis. Although there is the potential for accidental events, the WPA proposed action would not significantly change the water quality of the Gulf of Mexico over a large spatial or temporal scale.

4.1.1.2.2.4. Cumulative Impacts

A detailed description of cumulative impacts upon water quality can be found in Chapter 4.5.2 of the Multisale EIS and in Chapter 4.1.2.1.4 of the 2009-2012 Supplemental EIS.

Activities in the cumulative scenario that could impact offshore water quality generally include the broad categories of the proposed action and the OCS Program, the activities of other Federal agencies (including the military), natural events or processes, State oil and gas activity, and activities related to the direct or indirect use of land and waterways by the human population (e.g., urbanization, agricultural practices, coastal industry, and municipal wastes). Although some of these impacts are likely to affect coastal areas to a greater degree, coastal pollutants that are transported away from shore would still affect offshore environments. Many of these categories would have some of the same specific impacts (e.g., vessel traffic would occur for all of these categories except natural processes).

Sediment disturbance and turbidity may result from pipeline installation, installation and removal of platforms, discharges of muds and cuttings from drilling operations, disposal of dredge materials, sand borrowing, sediment deposition from rivers, and hurricanes. Turbidity is also influenced by the season. In offshore waters, these impacts may be the result of Gulfwide, OCS-related activities by other Federal agencies, including the military, and natural processes. State oil and gas activities may have some effect if they take place near offshore waters. Dredging projects related to restoration or flood prevention measures may be directed by the Federal Government for the benefit of growing coastal populations. These impacts generally degrade water quality locally and are not expected to last for long time periods. Furthermore, discharges from drilling platforms are regulated by USEPA through the NPDES permit process; thus, effects from these discharges should be limited.

Vessel discharges can degrade water quality. Vessels may be service vessels supporting the proposed action, OCS-related activities, or State oil and gas activities. However, the vessels may also be vessels used for shipping, fishing, military activities, or recreational boating. State oil and gas activities, fishing, and recreational boating would have fewer effects on offshore waters, except for larger fishing operations and cruise lines, as smaller vessels tend to remain near shore. Fortunately, for many types of vessels, most discharges are treated or otherwise managed prior to release through regulations administered by USCG and/or USEPA, and many regulations are becoming more stringent. For example, the USCG Ballast Water Management Program, which was designed to prevent the introduction of invasive species, became mandatory for some vessels in 2004 (33 CFR 151 Subparts C and D) (U.S. Dept. of Homeland Security, CG, 2010b). Furthermore, USCG published the Ballast Water Discharge Standard Notice of Proposed Rulemaking in the *Federal Register* on August 28, 2009 (*Federal Register*, 2009c). Additionally, the final Vessel General Permit, issued by USEPA, became effective on December 19, 2008. This permit is in addition to already existing NPDES permit requirements and now increases the NPDES regulations so that discharges incidental to the normal operation of vessels operating as a means of transportation are no longer excluded unless exempted from NPDES permitting by Congressional legislation (USEPA, 2008b). These regulations should minimize the cumulative impacts of vessel activities.

Erosion and runoff from point and nonpoint sources degrade water quality. Nonpoint-source runoff from onshore support facilities could result from OCS-related activities as well as State oil and gas activities and other industries and coastal development. Although offshore waters would not be affected as strongly as coastal waters since contaminants would be more diluted by the time they reached offshore areas, in many cases this runoff would still contribute somewhat to the degradation of offshore waters. Urban runoff can include suspended solids, heavy metals and pesticides, oil and grease, and nutrients. Urban runoff increases with population growth, and the Gulf Coast region has experienced a 103 percent population growth since 1970 (USDOC, NOAA, 2008a). The National Research Council (2003, Table I-4, p. 237) estimated that on average approximately 26,324 bbl of oil per year entered Gulf waters from petrochemical and oil refinery industries in Louisiana and Texas. Chapter 4.1.3.4 of the Multisale EIS discussed the various sources of petroleum hydrocarbons that can enter the Gulf of Mexico in further detail. The natural emptying of rivers into the GOM as part of the water cycle may introduce chemical and physical factors that alter the condition of the natural water through both natural and anthropogenic sources, such as the addition of waterborne pollutants, or the addition of warmer water, into the GOM through waterbodies emptying into the GOM, runoff, groundwater discharge, or precipitation. The Mississippi River introduced approximately 3,680,938 bbl of oil and grease per year from land-based sources (NRC, 2003, Table I-9, p. 242) into the waters of the Gulf. Nutrients carried in Texas and Louisiana rivers contribute to seasonal formation of hypoxic zones on the Texas and Louisiana shelf. The USEPA also regulates point-source discharges. Chapter 4.5.2.1 of the Multisale EIS summarizes the USEPA's regulatory programs designed to protect the waters that enter the Gulf. If these and other water quality programs and regulations continue to be administered and enforced, it is not expected that additional oil and gas activities would adversely impact the overall water quality of the region.

Offshore waters, especially deeper waters, are more directly affected by natural seeps since the natural seeps in the Gulf of Mexico are located in offshore waters. Natural seeps are the result of natural processes. Hydrocarbons enter the Gulf of Mexico through natural seeps in the Gulf of Mexico at a rate of approximately 980,392 bbl/yr (a range of approximately 560,224-1,400,560 bbl/yr) (NRC, 2003, p. 191). Hydrocarbons from natural seeps are considered to be the highest contributor of petroleum hydrocarbons to the marine environment (NRC, 2003, p. 33). However, studies have shown that benthic communities are often acclimated to these seeps and may even utilize them to some degree (NRC, 2003, references therein and p. 33).

Discharges from exploration and production activities can degrade water quality in offshore waters. The USEPA regulates discharges associated with offshore oil and gas exploration, development, and production activities on the OCS under the Clean Water Act's NPDES program. Regulated wastes include drilling fluids, drill cuttings, deck drainage, produced water, produced sand, well treatment fluids, well completion fluids, well workover fluids, sanitary wastes, domestic wastes, and miscellaneous wastes (USEPA, 2009). The bulk of waste materials produced by offshore oil and gas activities are produced water (formation water) and drilling muds and cuttings. Produced water is the largest waste stream by volume from the oil and gas industry that enters Gulf waters. The NRC has estimated the quantity of produced water entering the Gulf per year to be 473,000 bbl (NRC, 2003, p. 200, Table D-8). However, produced water is commonly treated to separate free oil and, as noted above, is a regulated discharge. Since discharges from drilling and production platforms are regulated by USEPA through the NPDES permit process, the effects from these discharges should be limited.

Since the marine environment is a dynamic system, sediment quality and water quality can affect each other. For example, a contaminant may react with the mineral particles in the sediment and be removed from the water column (e.g., adsorption). Thus, under appropriate conditions, sediments can serve as sinks for contaminants such as metals, nutrients, or organic compounds. However, if sediments are (re)suspended (e.g., due to a storm event), the resuspension can lead to a temporary redox flux, including a localized and temporal release of any formally sorbed metals as well as nutrient re-cycling (Caetano et al., 2003; Fanning et al., 1982).

Accidental releases of oil, gas, or chemicals would degrade water quality during and after the spill until either the spill is cleaned up or natural processes degrade or disperse the spill. These accidental releases could be a result of the proposed action, ongoing OCS activity, State oil and gas activity, the transport of commodities to ports, and/or coastal industries. Actions taking place directly in offshore waters would generally have more significant impacts on offshore waters. The impacts of rare, catastrophic spills are discussed in **Appendix B**. The extent of impact from a spill depends on the behavior and fate of oil in the water column (e.g., the movement of oil and the rate and nature of weathering), which, in turn, depends on oceanographic and meteorological conditions at the time (Appendices A.2 and A.3 of the Multisale EIS). Chapter 4.5.2.1 of the Multisale EIS contains more information on accidental releases. A major hurricane can result in a greater number of spill events with increased spill volume and decreases in oil-spill-response times. In the case of an accidental event, it is likely that response efforts would reduce the amount of oil. See **Chapter 3.2.1.5** for further discussion of oil-spill-response considerations. Offshore water quality would not only be impacted by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts. Increased vessel traffic and the addition of dispersants and methanol to the marine environment in an effort to contain, mitigate, or clean up the oil may also tax the environment to some degree.

Summary and Conclusion

Water quality in offshore waters may be impacted by sediment disturbance and suspension (i.e., turbidity), vessel discharges, erosion and runoff of nonpoint-source pollutants including river inflows, natural seeps, discharges from exploration and production activities, and accidental events. These impacts may be a result of the proposed action and the OCS Program, the activities of other Federal agencies (including the military), private vessels, and natural events or processes. To a lesser degree, these impacts may also be a result of State oil and gas activity or activities or related to the direct or indirect use of land and waterways by the human population (e.g., urbanization, agricultural practices, coastal industry, and municipal wastes). Routine activities that increase turbidity and discharges are temporary in nature and are regulated; therefore, these activities would not have a lasting adverse impact on water quality. In the case of a large-scale spill event, degradation processes would decrease the amount of spilled oil over time through natural processes that can physically, chemically, and biologically degrade the oil (NRC, 2003). The impacts resulting from the WPA proposed action are a small addition to the cumulative impacts on the offshore waters of the Gulf, when compared with inputs from natural hydrocarbon inputs (seeps), coastal factors (such as erosion and runoff), and other non-OCS industrial discharges. The incremental contribution of the routine activities and accidental discharges associated with the proposed action to the cumulative impacts on coastal water quality is not expected to be significant.

4.1.1.3. Coastal Barrier Beaches and Associated Dunes

The BOEMRE has reexamined the analysis for coastal barrier beaches and associated dunes presented in the Multisale EIS and the 2009-2012 Supplemental EIS (addition of 181 South Area), based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusion for coastal barrier beaches and associated dunes presented in the Multisale EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS. A summary of those analyses and their reexamination due to new information is presented in the following sections. A brief summary of potential impacts follows. Routine activities associated with the WPA proposed action, such as increased vessel traffic, maintenance dredging of navigation canals, and pipeline installation, would cause negligible impacts and would not deleteriously affect coastal barrier beaches and associated dunes. Indirect impacts from routine activities are negligible and indistinguishable from direct impacts of onshore activities. The potential impacts from accidental events, primarily oil spills, associated with the WPA proposed action are anticipated to be minimal. The incremental contribution of the proposed action to the cumulative impacts to coastal barrier beaches and associated dunes is expected to be small.

4.1.1.3.1. Description of the Affected Environment

A detailed description of coastal barrier beaches and associated dunes in the Gulf of Mexico can be found in Chapter 3.2.1.1 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.3.1.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The coastal environments discussed here are those barrier beaches and associated dunes that might be impacted by activities resulting from the proposed action. Geographically, the discussion covers coastal areas that range from the Texas/Louisiana border to the State of Tamaulipas, Mexico. Although seemingly similar biological environments occur in each of those subareas, they vary significantly. For that reason, the following environmental descriptions of this coast are organized into two geologic subareas: (1) the barrier island complex of northern Tamaulipas, Mexico, and southern Texas; and (2) the Chenier Plain of eastern Texas. Tidal influences can be seen 25-40 mi (40-64 km) inland in some areas of Texas due to large bay complexes, channelization, and low topographies. Wind-driven tides are often dominant over the minimal gravity tides that occur there.

Since the last analysis and description of the WPA, the frequency and intensity of hurricanes in or near the WPA, as well as one of the largest oil spills ever recorded in the U.S. (DWH event), occurred in the adjacent Louisiana waters. As a result of both these natural and manmade factors, the existing condition of the barrier and beach resources has been altered. The descriptive narrative of the existing condition of the resources includes a brief insight into barrier island and beach formation and also highlights the changed environment of some of these resources as a result of the various natural (hurricanes) and manmade (DWH event) forces that define the present state of the resource. The initial discussion of barrier island and beach formation discussed in Chapter 4.1.1.3.1 of the 2009-2012 Supplemental EIS and can be applied to the Gulf Coast for the WPA. Following that discussion is information discussed particular to the upper Texas coast.

Barrier islands make up more than two-thirds of the northern Gulf of Mexico shore. Each of the barrier islands is either high profile or low profile depending on the elevations and morphology of the island (Morton et al., 2004). Ocean-wave intensities around the Gulf are generally low to moderate. These shorelines are usually sandy beaches that can be divided into several interrelated environments. Generally, beaches consist of a shoreface, foreshore, and backshore. The shoreface slopes downward and seaward from the low-tidal water line, under the water. The nonvegetated foreshore slopes up from the ocean to the beach berm-crest. The backshore is found between the beach berm-crest and the dunes, and may be sparsely vegetated. The berm-crest and backshore may occasionally be absent due to storm activity.

The dune zone of a barrier landform can consist of a single low dune ridge, several parallel dune ridges, or a number of curving dune lines that may be stabilized by vegetation. These elongated, narrow landforms are composed of wind-blown sand and other unconsolidated, predominantly coarse sediments.

Sand dunes and shorelines conform to environmental conditions found at a site. These conditions usually include waves, currents, wind, and human activities. When Gulf waters are elevated by storms, waves are generally larger and can overwash lower coastal barriers, creating overwash fans or terraces behind and between the dunes. With time, opportunistic plants will reestablish on these flat, sand terraces, followed by the usual vegetative succession for this area. Along more stable barriers, where overwash is rare, the vegetative succession in areas behind the dunes is generally complete. Vegetation in these areas of broad flats or coastal strands consists of scrubby woody vegetation, marshes, and maritime forests. Saline and freshwater ponds may be found among the dunes and on the landward flats. Landward, these flats may grade into wetlands and intertidal mud flats that fringe the shore of lagoons, islands, and embayments. In areas where no bay or lagoon separates barrier landforms from the mainland, the barrier vegetation grades into scrub or forest habitat of the mainland.

Larger changes to barrier landforms are primarily due to storms, subsidence, deltaic cycles, longshore currents, and human activities. Barrier landform configurations continually change, accreting and eroding, in response to prevailing and changing environmental conditions. Landform changes can be seasonal and cyclical, such as seen with the onshore movement of sand during the summer and offshore movement during the winter, which is due to seasonal meteorological and wave-energy differences. Noncyclical changes in landforms can be progressive, causing landform movement landward, seaward, or laterally along the coast.

Lateral movement of barrier landforms is of particular importance. As headlands and beaches erode, their sediments are transported offshore or laterally along the shoreline. Eroding headlands typically extend sand spits that may enclose marshes or previously open, shallow Gulf waters. By separating inshore waters from Gulf waters and slowing the dispersal of freshwater into the Gulf, movements of barrier landforms contribute to the area and diversity of estuarine habitat along a coast. Most barrier islands around the Gulf are moving laterally to some degree. Where this occurs, the receding end of the island is typically eroding; the leading end accretes. These processes may be continuous or cyclic.

Accumulations and movements of sediments that make up barrier landforms are often described in terms of regressive and transgressive sequences. Transgressive landforms dominate around the GOM. A transgressive sequence moves the shore landward, allowing marine deposits to form on terrestrial sediments. Transgressive coastal landforms around the Gulf have low profiles and are characterized by narrow widths; low, sparsely vegetated, and discontinuous dunes; and numerous, closely spaced, active washover channels. Landward movement or erosion of a barrier shoreline may be caused by any combination of the following factors: subsidence, sea-level rise, storms, channels, groins, seawalls, and jetties. These influences are discussed in the cumulative impact analysis (**Chapter 4.1.1.3.4**). Movement of barrier systems is not a steady process because the passage rates and intensities of cold fronts and tropical storms, as well as intensities of seasons, are not constant (Williams et al., 1992). A regressive sequence deposits terrestrial sediments over marine deposits, building land into the sea, as would be seen during deltaic land-building processes. Regressive barriers have high and broad dune profiles. These thick accumulations of sand may form parallel ridges.

Barrier islands, particularly vegetated ones with freshwater and or saltwater pools, may serve as habitat for a wide variety of animal life, especially birds. The islands and spits protect the bays, lagoons, estuaries, salt marshes, seagrass beds, and other wetland environments, some of which may contain threatened or endangered species.

The barrier islands from Texas to Florida all incurred some type of damage from the combination of Hurricanes Katrina, Rita, Gustav, and Ike and in some cases in combination with Hurricane Wilma as well. Hurricane Katrina in August 2005 caused severe erosion and landloss for the coastal barrier islands of the deltaic plain. Although barrier islands and shorelines have some capacity to regenerate over time, the process is very slow and often incomplete. With each passing storm, the size and resiliency of these areas can be diminished, especially when several major storms occur within a short time period.

Each of the barrier islands is either high profile or low profile depending on the elevations and morphology of the island (Morton et al., 2004). The height and continuity of these elevations determine the ability of the barriers to withstand storm-surge flooding and overwash. Barrier islands, particularly vegetated ones with freshwater and or saltwater pools, may serve as habitat for a wide variety of animal life, especially birds. The islands and spits protect the bays, lagoons, estuaries, salt marshes, seagrass beds, and other wetland environments, some of which may contain threatened or endangered species.

Upper Texas Coast

The barrier islands along the northeast Texas coast were severely eroded, losing 1 ft (0.3 m) in elevation and retreating landward 98 ft (30 m) between 2001 and 2005, as a result of a combination of Hurricanes Katrina/Rita and other previous storms (Newby, 2007). The overall analysis showed gains and losses along the barrier beaches, with a general landward retreat; however, in some areas, a parallel strip of elevation gain is also noted. In these areas, the material from the beach was overwashed landward of the beach ridge with sediment deposited into low-lying areas. The McFaddin National Wildlife Refuge, Texas Point National Wildlife Refuge, Sea Rim State Park, and J.D. Murphree State Wildlife Management Area comprise the McFaddin Complex, which contains approximately 60,000 ac (24,280 ha) of coastal marsh (i.e., fresh, intermediate, and brackish), coastal prairie (nonsaline and saline), coastal woodlands, and beach/ridge habitats in Jefferson and Chambers Counties in southeast Texas (USDOC, NMFS, 2007a). The beaches and ridges along the McFaddin Complex were already experiencing a historic erosion rate of 5-7 ft/yr (1.5-2.1 m/yr) prior to Hurricanes Katrina and Rita. Post-Hurricane Rita, a remnant dune/beach system still exists, although much has been lost through erosion and shoreline retreat, leaving only a low-lying, washover terrace. Loss of the existing beach dunes and the lowering of beach ridge elevations along the Gulf shoreline of the McFaddin Complex from Hurricane Rita puts approximately 30,000 ac (12,146 ha) of nationally significant wetlands at risk for saltwater intrusion (Doran et al., 2009).

Recent long-term retreat along the upper Texas coast has been reported at rates of 3-15 ft/yr (1-5 m/yr). Shorelines of area bays are eroding at rates averaging 2 ft/yr (61 cm/yr), but in some places as much as 10 ft/yr (305 cm/yr). However, along these same reaches there are "swash" zones where the back and forth action of the waves pick up and deposit sand on the beach face. Landward of these "swash zones" is the main beach or "storm beach" only reached by storm tides (Anderson, 2007). The large amount of sand moved up on the beaches eventually forms a series of beach ridges and dunes. It is these topographic features that protect the coast from washover. However, as the beach moves landward, the dune system moves with it. The same orbital motion in the nearshore "swash zone" that efficiently transports sand beachward is also at work in the deeper nearshore waters of the upper Texas coast. The wave amplitude in these deeper waters creates an even more efficient transport system in this offshore "swash zone" and makes it very efficient as a sediment transport mechanism. It is because of this action that a series of bars and depressions called runnels are formed along the coast.

The prevailing winds along the upper coast approach from the southeast, while the sand-bearing longshore currents run east to west. These longshore currents bring the much needed sand to shore and nourish the beaches. Weather systems from November to March cause winds along the upper coast that blow from the shore Gulfward, dampening the effect of the sand transport from the longshore currents. The winds shift in northerly and southeasterly directions causing higher tides; therefore, beaches expand and contract accordingly. Along the upper Texas coast, not only is the beach retreating, but the shoreface is also retreating at the same rate as the beach (Anderson, 2007). The sand from the old deltas formed during the fall of sea level replenish the receding beaches along the newly evolving coast. As these coastal processes evolve in combination with manmade modifications, the coast becomes more vulnerable to storms and tidal surge.

Texas and Mexican Barrier Island Complex

The Gulf coastline of Texas is about 367 mi (590 km) long. The State of Tamaulipas, in northeastern Mexico, has a Gulf coastline of about 235 mi (378 km). The barrier islands of both areas are mostly accreted sediments that were reworked from river deposits, previously accreted Gulf shores, bay and lagoon sediments, and exposed seafloors (White et al., 1986). This reworking continues today as these barrier beaches and islands move generally to the southwest (Price, 1958). During the period from about 1850 to 1975, net coastal erosion occurred in the following three groups of counties in Texas: (1) Cameron, Willacy, and southern Kennedy; (2) northern Matagorda, Brazoria, and southern Galveston; and (3) Jefferson, Chambers, and far northern Galveston (Morton, 1982). These generalized trends seem to be continuing. Padre Island is moderately regressive; the shoreline is retreating and more land is being exposed. It is typically 5-10 ft (1.5-3 m) above sea level and occasionally overwashed by hurricane surges. On the northern portion, some dunes may rise 20-30 ft (6-9 m), and the dune ridge is generally continuous. On the southern portion, the dune ridge is a series of short discontinuous segments. The dry winds and arid nature of this southern portion destabilize sand dunes. Sand flats and coppice dunes (small windblown sand mounds that form behind vegetation such as small shrubs) occupy the southern portion of the island. Any activity that reduces the sparse vegetation cover of this area initiates erosion. Vegetation on Padre Island is generally sparse, becoming sparser on its southern portion. The vegetation largely consists of grasses and scrubby, woody growth (Brown et al., 1977).

Exceptions to the above are the once regressive Matagorda Peninsula and Rio Grande Headland. The Matagorda Peninsula accreted as the Brazos-Colorado River Delta. Later, the peninsula became transgressive and the sediments were reworked to form flanking arcs of barrier sand spits. Washover channels cut the westward arc of the peninsula, forming barrier islands. The Rio Grand Headland has also become transgressive, and sand spits formed to its north and south. Today, longshore drift is southerly at these sites. Their northern spits are now eroding and their southern spits are accreting. Padre Island is moderately regressive; the shoreline is retreating and more land is being exposed. It is typically 5-10 ft (1.5-3 m) above sea level and occasionally overwashed by hurricane surges. On the northern portion, some dunes may rise 20-30 ft (6-9 m), and the dune ridge is generally continuous. On the southern portion, the dune ridge is a series of short discontinuous segments. The dry winds and arid nature of this southern portion destabilize sand dunes. Sand flats and coppice dunes occupy the southern portion of the island. Any activity that reduces the sparse vegetation cover of this area initiates erosion. Vegetation on Padre Island is generally sparse, becoming sparser on its southern portion. The vegetation largely consists of grasses and scrubby, woody growth.

The barrier islands along the northeast Texas coast were severely eroded, losing 1 ft (0.3 m) in elevation and retreating landward 98 ft (30 m) between 2001 and 2005, as a result of a combination of Hurricanes Katrina/Rita and other previous storms (Newby, 2007). The beaches of Galveston Island and Bolivar Peninsula are locally eroding or accreting. Accreting shorelines have a distinct beach berm and a wide back beach. Eroding beaches are relatively narrow, and the beach berm and back beach may be absent. Construction of seawalls and jetties on Galveston Island has contributed to erosion there, as discussed further in **Chapter 4.1.1.3.4**. While the Texas coast was spared major damage from Hurricane Gustav, it took the brunt of Hurricane Ike. The most extensive damage occurred on the Bolivar Peninsula as a result of the overtopping of dunes and breeching beach ridges, resulting in reduced dune height or, in some cases, the removal of the dunes completely. Closer to the location of peak surge, just east of High Island, Texas, the flood waters were high enough to completely submerge the barrier islands as the surge flowed rapidly back into the Gulf of Mexico. Dune-height changes exceeding 3 ft (1 m) were observed more than 32 mi (60 km) to the east of the landfall position, while dune-height changes exceeding 3 ft (1 m) were observed as far as 25 mi (40 km) to the west of landfall. In Galveston, Texas, the seawall is considered to be the dune crest, and the elevation change is roughly 12 in (30 cm), which is consistent with the previously determined vertical offset. Galveston Island had partial seawall protection along the beach front, lessening the erosion of shoreface to areas in front of the seawall. On the sandy beaches west of the seawall, peak dune elevations before the storm were 7-13 ft (2-4 m), roughly half of the elevation of the seawall. The coastal change along this unprotected stretch of Galveston Island was considerably more than on the sea-walled section nearby, but it was less than the visible impacts on the Bolivar Peninsula.

Shoreline erosion of 492 ft (150 m) was observed near Gilchrist, Texas. More than 164 ft (50 m) of shoreline erosion was experienced over a wide region from the seawall, extending 9 mi (15 km) to the west. The area of positive shoreline change at the south end of Galveston Island is related to spit formation at San Luis Pass and may not be related to Hurricane Ike. The area of positive shoreline change 50 mi (80 km) to the east of landfall is due to the seaward transport of sediment as storm water drained from the marshes (Doran et al., 2009). Only general, qualitative damage assessments using aerial photography have been prepared to date by USGS for impacts associated with Hurricane Gustav.

Other upper Texas beaches and lagoons affected by the hurricane surge of Ike include the wildlife refugees along the Texas coast and the J.D. Murphree State Wildlife Management Area, which received the most substantial damage to dunes, beaches, and marsh ponds. West of Hurricane Ike's landfall, the differences in the storm surge, winds, and waves, as well as higher coastal elevations, all worked together to lessen the storm's impact on the coast.

Chenier Plain

The Chenier Plain of eastern Texas and western Louisiana began developing about 2,800 years ago. During that period, Mississippi River Delta sediments were intermittently eroded, reworked, and carried into the Chenier Plain area by storms and coastal currents. This deposition gathered huge volumes of mud and sand, forming a shoreface that slopes very gently, almost imperceptibly, downward for a very long distance offshore. This shallow mud bottom is viscous and elastic, which generates hydrodynamic friction (Bea et al., 1983). Hence, wave energies along the barrier shorelines of the Chenier Plain are greatly reduced, causing minimal longshore sediment transport along the Chenier Plain (USDOI, GS, 1988). More recently, this shoreline has been eroding as sea level rises, converting most of this coast to transgressive shorelines.

Today, the Red River and about 30 percent of the Mississippi River are diverted to the Atchafalaya River. The diversions have increased the sediment load in the longshore currents, which generally move slowly westward along the coast.

The barrier beaches of the Chenier Plain are generally narrow, low, and sediment starved due to the natures of coastal currents and the shoreface. Here and there, beach erosion has exposed relic marsh terraces that were buried by past overwash events. West of about Fence Lake, Texas, the beach is fairly typical, being composed of shelly sand; although, it is no more than 200 ft (61 m) wide. Its shoreface sediments are similar to those shelly sands found in the upper portion of the shoreface (Fisher et al., 1973). East of Fence Lake, the shoreface contains discontinuous mud deposits among muddy sands. During low tides, extensive mudflats are exposed east and west of Fence Lake. The beach in this area is much narrower and becomes a low escarpment, where wave action cuts into the salt marsh (Fisher et al., 1973). Hurricane Rita (September 2005) severely impacted the shoreface and beach communities of Cameron Parish in southwest Louisiana. Some small towns in this area have no standing structures remaining. A storm surge approaching 20 ft (6 m) caused beach erosion and overwash, which flattened coastal dunes depositing sand and debris well into the backing marshes.

Deepwater Horizon Event Oil Exposure

In April 2010, the explosion of the DWH drilling platform resulted in the largest oil spill in the history of U.S. The spill was approximated at 4.9 million barrels; the well was capped on July 15, 2010, after oil flowed into the Gulf for 87 days. The drilling rig was located west of the Mississippi River approximately 40 mi (63 km) from the Louisiana coast. The bulk of the oil was off the coast of Louisiana, but eventually the oil spread east of the Mississippi River along the Mississippi, Alabama, and Florida coastlines as far away as Panama City, Florida. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). The potential oiling footprint as reported through NOAA's Environmental Response Management Application (ERMA), posted on the GeoPlatform.gov website, did not indicate oil in the surface waters of the WPA (USDOC, NOAA, 2011a). Although Shoreline Cleanup Assessment Teams (SCAT) did not sample Texas beaches, there was one confirmation of tarballs from the DWH event washing up on

Bolivar Peninsula, McFaddin Refuge, and Galveston Island, Texas (USDOC, NOAA, 2010c and 2011a; RestoretheGulf.gov, 2010a). Relatively small quantities (7 gallons) of tarballs were documented by the Texas General Land Office on east Galveston and Crystal beaches, as well as on the Bolivar Penisular. Along the beaches of the McFaddin National Wildlife Refuge, tarballs ranged from baseball to floormat size expanses, but they were not continuous, and overall coverage was moderate to light (*Austin Post*, 2010, interview with the Texas General Land Office). The tarballs from all beach sites were tested by the USCG's Marine Safety Lab in Connecticut and were found to be a positive match to the DWH oil (*Austin Post*, 2010, interview with Texas General Land Office). The oil was slightly weathered and likely did not travel to the Texas beaches from the source of the spill (RestoretheGulf.gov, 2010a). It is more likely that the tarballs formed from residue that reached the Texas coast through transport by response vessels (Restore the Gulf.gov, 2010a). Due to the distance of the Macondo well from the WPA, treatment of the oil by dispersants, weathering and biodegradation, and its immediate cleanup, the impacts from these tarballs to the WPA are expected to be minimal.

4.1.1.3.2. Impacts of Routine Events

Background/Introduction

Impacts to the general vegetation and physical aspects of coastal environments by routine activities resulting from the WPA proposed action are considered in detail in Chapters 4.2.1.1.3.1 of the Multisale EIS and in Chapter 4.1.3.1.2 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The major routine impact-producing factors associated with the proposed action that could affect these environments include navigational traffic, maintenance dredging of navigational canals, and construction and expansions of navigational canals and port facilities (**Chapter 3.1**). Although remnant oil was detected intermittently in the Gulf environment as a result of the DWH event in the fall of 2010, there was no evidence of this oil in the WPA. This remnant oil has been treated with dispersants and weathered, but it has the potential for resuspension as a result of the routine activities noted above. If encountered, the remnant oil is expected to be nontoxic due to natural weathering, microbial breakdown, and post-spill dispersant treatment.

This section considers impacts from routine activities associated with the WPA proposed action to the physical shape and structure of barrier beaches and associated dunes. These activities include pipeline emplacements, navigation channel use (vessel traffic), dredging, and construction of support infrastructure.

Pipeline Emplacements

Where a pipeline crosses the shoreline is referred to as a pipeline landfall. Pipeline landfall sites on barrier islands could accelerate beach erosion and island breaching. Studies have shown that little to no impact to barrier beaches results from pipeline landfalls that employ modern installation techniques, such as directional boring (LeBlanc, 1985; Mendelssohn and Hester, 1988; Wicker et al., 1989).

Vessel Traffic and Dredging

Vessel traffic that may support the proposed action is discussed in **Chapter 3.1.1.4** of this Supplemental EIS and in Chapter 4.1.1.8.4 of the Multisale EIS. Navigation channels projected to be used in support of the WPA proposed action are discussed in **Chapter 3.1.2** of this Supplemental EIS and in Chapter 4.1.2.1.9 of the Multisale EIS. Navigation channels that support the OCS Program are listed in Table 3-36 of the Multisale EIS. Current navigation channels would not change and no new navigation channels are required as a result of the WPA proposed action.

Waves generated by boats, ships, barges, and other vessels erode unprotected shorelines and accelerate erosion in areas already affected by natural erosion processes. These processes are due to shoreline and hydrological changes resulting from localized subsidence and passages of seasonal and tropical storms. Much of the service-vessel traffic that is a necessary component of OCS activities uses the channels and canals along the Texas and Louisiana coasts. According to Johnson and Gosselink

(1982), canal widening rates in coastal Louisiana range from about 2.58 m/yr (8.46 ft/yr) for canals with the greatest boat activity to 0.95 m/yr (3.12 ft/yr) for canals with minimal boat activity. The OCS-related navigation canals are assumed to generally widen at an average rate of 1.5 m/yr (4.9 ft/yr). This is 300 ha (741 ac) of landloss per year for the 700 km (435 mi) of OCS-related navigation channels in the WPA. If a navigation channel is too large for storm/tidal exchange to keep it clear, it would generally capture and remove sediment from longshore drift with sandbars. Periodic maintenance dredging is expected in existing OCS-related navigation channels through barrier passes and associated bars. Jetties or bar channels (from maintenance dredging) serve as sediment sinks by intercepting sediment in longshore drift. Dredging removes sediment from the littoral sediment drift or re-routes sediment around the beach, which is immediately downdrift of the involved channel. Materials from maintenance dredging of bar and pass channels are typically discharged to nearby ocean dumping sites in the Gulf, or they are now used for beneficial uses such wetlands or beach renourishment projects.

Continued Use of Support Infrastructure

No onshore infrastructure used to support OCS operations has been constructed recently on barrier beaches in Texas or Louisiana. The use of some existing facilities in support of the WPA proposed action may extend the useful lives of those facilities. During that extended life, erosion-control structures may be installed to protect a facility. Although these measures may initially protect the facility as intended, such structures may accelerate erosion elsewhere. They may also cause the accumulation of sediments updrift of the structures. Those sediments might have alleviated erosion downdrift of the structure. These induced erosion impacts would be most damaging locally. In Louisiana, where the sediment supply is critically low, these impacts may be distributed much more broadly. These impacts would last as long as the interruption of the sediment drift continues, and that can continue after the structure is removed if the hydrodynamics of the area are permanently modified. Recent successive hurricanes (Katrina, Rita, Gustav, and Ike) have damaged barrier islands along the Texas and Louisiana coasts and have accelerated erosion and have undermined pipelines and support structures in some areas. Expansions of existing facilities located on barrier beaches or associated dunes would cause loss and disturbance of additional habitat. Abandoned facility sites must be cleared in accordance with Federal, State, and local government, and landowner requirements. All materials and structures that would impair or divert sediment drift among the dunes and on the beach must be removed.

Proposed Action Analysis

Zero to one pipeline landfalls are projected as a result of the WPA proposed action. Should one be constructed, it would most likely be in the northeastern coast of Texas, where the large majority of the pipelines from the WPA come ashore. Such a landfall may occur in the immediate vicinity of a barrier beach and associated dunes. Wherever a landfall occurs, Federal and State regulatory programs and permitting processes encourage the use of directional boring technology to greatly reduce and perhaps eliminate impacts to barrier beaches or dunes. Therefore, effects on barrier beaches and dunes from pipeline laying activities associated with the WPA proposed action are expected to be minor or nonexistent. These impacts are considered to be negligible.

Turner and Cahoon (1988) found that OCS traffic comprises a relatively small percentage (~12%) of the total commercial traffic using navigation channels; the average contribution of vessel traffic of a WPA proposed action to the total OCS-related vessel traffic in navigation canals is expected to be small (3-4%), and the contribution from the proposed action is even less. Erosion of coastal barrier beaches and associated dunes from vessel traffic associated with the WPA proposed action are expected to be negligible.

Adverse impacts from maintenance dredging of navigation channels can be mitigated by discharging dredged materials onto barrier beaches, strategically into longshore sediment currents downdrift of maintained channels, or by using the dredged material to create wetlands. Adverse impacts of sediment sinks created by jetties can be mitigated by reducing the jetty length to the minimum needed and by filling the updrift side of the jetty with appropriate sediment. Sediment traps that are created by dredging large bar channels can be mitigated by reassessing the navigational needs of the port to reduce the depth of the channel. Mitigating adverse impacts should be addressed in accordance with requirements set forth by the appropriate Federal and State permitting agencies. Effects on coastal barrier beaches and dunes associated with dredging from the WPA proposed action are expected to be restricted to minor and localized areas downdrift of the channel. A gas processing plant associated with the WPA proposed action would not be expected to be constructed on barrier beaches. Effects on coastal barrier beaches and associated dunes associated with continued use of existing OCS gas processing plants and pipeline infrastructure from the WPA proposed action are expected to be restricted to minor and very localized areas downdrift of the facility or landfall site.

Summary and Conclusion

Effects to coastal barrier beaches and associated beaches from pipeline emplacements, navigation channel use and dredging, and construction or continued use of infrastructure in support of the WPA proposed action are expected to be restricted to temporary and localized disturbances. The 0-1 pipeline landfalls projected in support of the proposed action are not expected to cause significant impacts to barrier beaches because of the use of nonintrusive installation methods and regulations. The 0-1 gas processing plants would also not be expected to be constructed on barrier beaches. Existing facilities originally built inland may, due to natural erosion and shoreline recession, eventually be located in the barrier beach and dune zone and contribute to erosion there. The proposed action may contribute to the continued use of such facilities.

Maintenance dredging of barrier inlets and bar channels is expected to occur, which combined with channel jetties, generally causes minor and localized impacts on adjacent barrier beaches downdrift of the channel. These dredging activities are permitted, regulated, and coordinated by COE with the appropriate State and Federal resource agencies. Impacts from these operations are minimal due to requirements for the beneficial use of the dredged material for wetland and beach construction and restoration. Permit requirements further mitigate dredged material placement in approved disposal areas by requiring the dredged material to be placed in such a manner that it neither disrupts hydrology nor changes elevation in the surrounding marsh. Based on use, the proposed action would account for a very small percentage of these impacts, and this would occur whether the proposed action is implemented or not.

In conclusion, the WPA proposed action is not expected to adversely alter barrier beach configurations significantly beyond existing, ongoing impacts in localized areas downdrift of artificially jettied and maintained channels. The proposed action may extend the life and presence of existing facilities in eroding areas through modifications to channel training structures (jetties) and the utilization of beach restoration and nourishment techniques combined with dune restoration. Strategic placement of dredged material from channel maintenance, channel deepening, and related actions can mitigate adverse impacts upon those localized areas.

4.1.1.3.3. Impacts of Accidental Events

Background/Introduction

Impacts to the general vegetation and physical aspects of coastal environments by oil spills and cleanup response activities resulting from the WPA proposed action are considered in Chapters 4.4.3.1 of the Multisale EIS and in Chapter 4.1.3.1.3 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The types and sources of spills that may occur, and their characteristics, are described in Chapter 4.3.1 of the Multisale and in **Chapter 3.2** of this Supplemental EIS. There is also a risk analysis of accidental events in **Chapter 3.2.1**. Figures 4-13 and 4-14 of the Multisale EIS provide the probability of an offshore spill ≥1,000 bbl occurring and contacting counties and parishes around the Gulf. Potential impacts from oil spills to barrier islands seaward of the barrier-dune system are considered in this section, while potential impacts to barrier islands landward of the barrier-dune system are considered in the wetlands analysis (**Chapter 4.1.1.4.3**). Impacts to animals that use these environments, the recreational value of beaches, and archaeological resources found there are described in the impact analysis sections for those specific resources.

The passage of two powerful hurricanes in 2008 (Gustav and Ike) has resulted in changes in barrier island topography and the lowering of beach and dune ridge elevations. These changes potentially increase the probability for beach oiling farther up the beach in some locations along the Texas coast.

The 2008 hurricane season was devastating to both the Louisiana and east Texas coasts. Hurricanes Gustav and Ike impacted the coastal areas of Louisiana and Texas within a 2-week period. The Texas coast was spared major damage from Hurricane Gustav but it took the brunt of Hurricane Ike. The most extensive damage occurred on the Bolivar Peninsula, Texas, as a result of the overtopping of dunes and breeching beach ridges, resulting in reduced dune height and in some cases the removal of the dunes completely. Dune-height changes exceeding 1 m (3 ft) were observed more than 60 km (32 mi) to the east and 40 km (25 mi) to the west of Hurricane Ike's landfall. In Galveston, Texas, the seawall (considered to be the dune crest) elevation change was roughly 30 cm (12 in), which is consistent with the previously determined vertical offset (Doran et al., 2009).

Although only a few tarballs related to the DWH event reached the WPA, the DWH event may shed some light on potential exposures in the unlikely event of a future catastrophic event. Should a catastrophic spill such as the one associated with the DWH event occur in the proximity of the WPA, the implications of such a spill are discussed in **Appendix B**.

Coastal spills in offshore coastal waters or in the vicinity of Gulf tidal inlets present a greater potential risk to barrier beaches because of their close proximity. Inland spills that occur away from Gulf tidal inlets are generally not expected to significantly impact barrier beaches and dunes.

Proposed Action Analysis

These wetlands are generally more susceptible to contact by inshore spills, which have a low probability of occurrence from OCS-related activities. Inshore vessel collisions may release fuel and lubricant oils, and pipeline ruptures may release crude and condensate oil. Although the impact can occur over all coastal regions, the impact has the highest probability of occurring in Galveston and Matagorda Counties in Texas where the WPA oil is handled. An estimated 15-34 spills could occur in coastal waters from the WPA proposed action and its support operations (**Table 3-7**). Offshore oil spills are much less likely to contact these wetlands than are inshore spills because these areas are generally protected by barrier islands, peninsulas, sand spits, and currents. The probabilities of an offshore spill ≥1,000 bbl occurring and contacting environmental features are described in Chapter 4.3.1.8 of the Multisale EIS. Six counties in Texas have a chance of spill contact. For these counties, the chance of an OCS offshore spill ≥1,000 bbl occurring and reaching the shoreline ranges from 1 to 15 percent as the result of the proposed action over its 40-year life. Matagorda County has the largest probability (3-5%) of contact in the WPA. Weathering, wave action, and the use of offshore dispersants would reduce the amount of oil that would reach wetland areas and would result in minimal impacts.

For offshore spills <1,000 bbl, only those >50 bbl would be expected to have a chance of persisting as a cohesive slick long enough for the slick to reach land. Few offshore spills of 50-1,000 bbl are estimated to occur as a result of the proposed action, and few of these slicks are expected to occur proximate to State waters and to reach shore. Should a slick from such a spill make landfall, the volume of oil remaining in the slick is expected to be small (Chapter 4.3.1.6.1 of the Multisale EIS).

Approximately 15-34 spills are estimated to occur within Gulf coastal waters from activities supporting the WPA proposed action (**Table 3-7**). Most (about 90%) of these spills would be ≤1 bbl. The most likely locations of the estimated 5-10 coastal spills >1 bbl would be proximate to the major oil pipeline shore facilities. Up to one 3,000-bbl spill is spill estimated to occur in Louisiana and Texas coastal waters under the high resource-estimate scenario, BOEMRE estimates that coastal spills ≥1,000 bbl resulting from the proposed action would have a low probability of occurrence (Chapter 4.3.1.8 in the Multisale EIS).

Should a spill contact a barrier beach, oiling is expected to be light. It should be noted because of changes of topography from storm events oiling can occur farther up the beach. Sand removal during cleanup activities should be minimized, and invasive techniques required for deep sediment oiling should not be required. No significant impacts on the physical shape and structure of barrier beaches and associated dunes are expected to occur as a result of the proposed lease sale.

Oil Spill Impacts

The level of impacts from oil spills depends on many factors, including the type, rate, and volume of oil spilled; weather and oceanographic conditions at the time of the spill; geographic location; season; and oil-spill-response and cleanup preparedness. These parameters can determine the quantity of oil that is dispersed in the water column and the actual amount, concentration, toxicity, and composition of the oil at the time of the shoreline contact. All of those factors determine if an oil spill would cause heavy long-lasting biological damage, comparatively little damage, or no damage.

A study in Texas showed that oil disposal on sand and vegetated sand dunes had no deleterious effects on the existing vegetation or on the recolonization of the local plant community (Webb, 1988). This study had controlled, comparative lab studies and manmade dunes constructed with “oiled sands” (from crude oil spill off the Texas coast) to determine the effects of oil contamination on beach and dune vegetation. These “oiled sand” dunes were constructed with slopes comparable (60%) to those of natural dunes. Various types of dune vegetation (*Spartina patens*, *Panicum amarum, Rubus trivialis, Ambrosia psillostachya,* etc.) were tested to ascertain survivability and biomass production in the “oiled sands” and were compared with natural dunes. *Spartina* and *Panicum* species were the primary focus of the lab studies. The study indicated that *S. patens* had a 50 percent survival rate in “oiled sands” and a 38 percent survival rate in oil free sands in the lab studies. *P. amarum* had a 31 percent survival rate in both oiled and oil free conditions. Both *S. patens* and *P. amarum* were transplanted to oil-contaminated and oil free dunes. Survival of dune transplants was better for both species tested in the oil-contaminated dune (81%) than the oil-free (62%) dune. Not only did the vegetation survive but it also produced favorable biomass similar to natural conditions. Both the dune and lab experiments indicated that the oil did not prevent plant establishment. It was concluded that common dune plants can colonize or can be transplanted successfully into oil-contaminated sands. The researchers did note that oil reaching the beach would probably have undergone weathering from photo-oxidation, volatilization, and biodegradation. However, tests results of the oiled sands indicated that, while lighter toxic alkenes and cycle alkenes were absent in the “oiled sands,” 21 percent of the crude oil was water-insoluble PAH’s. Analysis of the weathered crude oil did not indicate a high percentage of PAH’s. It is concluded that the weathering process removed most of the toxic compounds (Webb, 1988).

There are various factors and conditions that affect the toxicity and severity of oil spills on the barrier island systems and the associated vegetation. The two most important variables are location (proximity of spill in distance from landfall) and weather. If there is sufficient distance and proper weather conditions between the spill and landfall, the spill can be dispersed and thinned out and optimal conditions are set for biodegradation, volatilization, and photo-oxidation of the more toxic components of the oil.

Oil-spill cleanup operations can affect barrier beach stability. If large quantities of sand are removed during spill-cleanup operations, a new beach profile and sand configuration would be established in response to the reduced sand supply and volume. The net result of these changes could be accelerated shoreline erosion rates, especially in a sand-starved and eroding-barrier setting such as found along the Louisiana Gulf Coast. To address these possible impacts, the Gulf Coast States have established policies to limit sand removal by cleanup operations.

Most inshore spills resulting from the proposed action would occur from barge, pipeline, and storage tank accidents involving transfer operations, leaks, and pipeline breaks. These are far from barrier beaches. When transporting cargoes to terminals, oil barges make extensive use of interior waterways. These interior waterways are remote from barrier beaches, so most inshore spills are assumed to have no contact with barrier beaches or dunes. For a barge or pipeline accident in State or Federal offshore waters to affect a barrier beach, the accident would need to occur on a barrier beach or dune or near a tidal inlet. Inshore pipelines or barge accidents are assumed to result in spilled oil contacting the inland shores of a barrier island, with unlikely adverse impacts to barrier beaches or dunes.

Oil that makes it to the beach can be either liquid weathered oil, an oil and water mixture, or tarballs. Oil is generally deposited on beaches in lines defined by wave action at the time of landfall. Initially, components of oil on the beach would evaporate more quickly under warmer conditions. Under high tide and storm conditions, oil may return to the Gulf and be carried higher onto the beach by future tidal events. Oil that remains on the beach would thicken as its volatile components are lost. Thickened oil may form tarballs or aggregations that incorporate sand, shell, and other materials into its mass. Tar may be buried to varying depths under the sand. On warm days, both exposed and buried tarballs may liquefy and ooze and can serve to expand the size of a mass as it incorporates beach materials.

Oil on the beach may be cleaned up manually, mechanically, or both methods. Removal of sand during cleanup is expected to be minimized to avoid significantly reducing sand volumes. Some oil would likely remain on the beach at varying depths and may persist for several years as it slowly biodegrades and volatilizes.

Summary and Conclusion

Because of the proximity of inshore spills to barrier islands and beaches, these inshore spills pose the greatest threat because of its concentration and lack of weathering by the time it hits the shore and because dispersants are not an effective means of spill response. Such spills may result from either vessel collisions that release fuel and lubricants or from pipelines that rupture. Impacts of a nearshore spill would be considered short term in duration and minor in scope because the size of such a spill is projected to be small (historical data indicate that coastal spills average <5 bbl; Table 4-13 of the Multisale EIS). Offshore-based crude oil would be less in toxicity when it reaches the coastal environments. This is due to the distance from shore, the weather, the time the oil remains offshore, and the dispersant used. Equipment and personnel used in cleanup efforts can generate the greatest direct impacts to the area, such as mechanized cleanup equipment (e.g., sifters) that would disperse oil deeper into sands and sediments and foot traffic that would impact the distribution of oils and marsh vegetation. Close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize those impacts.

The BOEMRE has reexamined the analysis for barrier island and beach resources presented in the Multisale EIS, based on the additional information presented above. Although the most current information did reveal that some of the barrier islands had experienced storm-induced reductions in beach shoreline elevations and erosion, the significance of this loss of protection is small in comparison with the overriding climatic forces (USDOC, NMFS, 2007a). Therefore, this information would not alter the overall conclusion that impacts on barrier islands and beaches from accidental impacts associated with the WPA proposed action would be minimal. Should a spill other than a catastrophic spill contact a barrier beach, oiling is expected to be light and sand removal during cleanup activities minimized. No significant long-term impacts to the physical shape and structure of barrier beaches and associated dunes are expected to occur as a result of the WPA proposed action. The current lease sale would not pose a significant increase in risk to barrier island or beach resources.

4.1.1.3.4. Cumulative Impacts

A detailed description of cumulative impacts upon barrier beaches and associated dunes can be found in Chapter 4.5.3.1 of the Multisale EIS and in Chapter 4.1.3.1.4 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Background/Introduction

This cumulative analysis considers the effects of impact-producing factors related to the proposed action, prior and future OCS sales in the Gulf of Mexico, State oil and gas activities, other governmental and private projects and activities, and pertinent natural processes that may affect barrier beaches and dunes. Specific impact-producing factors considered in this cumulative analysis include channelization of the Mississippi River, beach protection and stabilization projects, natural processes, navigation channels, development and urbanization, oil spills, oil-spill-response and cleanup activities, pipeline landfalls, potential for nearshore salinity modifications (preparation of salt domes for oil storage), tourism, and recreational activities.

Due to distance of the Macondo well from the WPA, currents, and winds, the DWH event had negligible physical effects on the Texas coast and coastal habitats. Only a small number of tarballs associated with the DWH event made their way to Texas beaches, and these are believed to have been formed from residue transported to the area by a few vessels traveling through the CPA. Based on available data, the lateral westward extent of the DWH spill only extended into Cameron Parish, Louisiana, where a sheen was noted. Neither the plume nor a sheen was detected in the WPA.

River Channelization and Beach Protection

In Louisiana, channel deepening and widening along the Mississippi River and other major coastal rivers, in combination with channel training and bank stabilization work, has resulted in the reduced delivery of sediment to the eroding deltas along the mouths of the rivers. This reduction in sediment not only impedes delta building, but it also fails to provide the needed sediment transport required for nourishment of the eroding offshore barrier islands and their beaches. This, coupled with beach building and stabilization projects utilizing mined sands, jetties, groins, and other means of sediment capture, is depriving natural restoration of the barrier beaches normally accomplished through sediment nourishment and sediment transport.

The Texas coast has experienced a natural decrease in sediment supply as a result of climatic changes (e.g., diminished rainfall) that have occurred during the past few thousand years and dam construction, both of which have resulted in the loss of sediment and sediment transport (Morton, 1982). As reported in Gibeaut et al. (2008), engineering modifications to the Brazos and Colorado Rivers in the form of river diversions and dredging allowed more sediment to reach the Texas coast. The cumulative effect of these actions have supplied sand and caused shoreline advance in the downdrift (southwest) direction. The jetties at the Matagorda Ship Channel have caused dramatic shoreline advance on the updrift (northeast) side but shoreline retreat on the downdrift (southwest) side. This landloss is related to the downdrift effect of the channel's jetties and the overall natural state of erosion along the coast. This shoreline will continue to retreat in the future until it intersects the hardened seawall and revetted shoreline at Sergeant Beach. This altered shoreline will reduce the sand supply, resulting in enhanced shoreline retreat. The seawall construction along eroding stretches of islands has reduced the amount of sediment introduced into the littoral system by erosion. The Texas Chenier Plain was created by reworked sediments from the Mississippi River depositions, which are now decreased by beach and channel stabilization and flood protection works. Reductions in sediment supply along the Texas coast will continue to have a significant adverse impact on barrier landforms there. Subsidence, erosion, and dredging of inland coastal areas and the concurrent expansion of tidal influences continue to increase tidal prisms around the Gulf. Over the course of geological history since the peak of the last ice age 18,000 years ago, the barrier islands have migrated toward the present coast. The Gulf-facing coasts of the barrier islands have been eroded by the steady rise in sea level. Historically, as the Gulf's coast retreated, the landward side of the islands has extended and has been built up by sand deposits from over wash during storms. Today that process has ceased in the case of many of the Texan barrier islands. The beaches of the islands are also being eroded by wave action increased by sea walls, jetties, and vegetated dunes. The islands are getting narrower through both natural processes and the influence of mankind. Human disturbance to the fragile natural environment has hastened the erosion of these natural storm barriers (Jones and Wells, 1987). These changes may result in the opening and deepening of many new tidal channels that connect to the Gulf and inland waterbodies. These incremental changes will cause adverse impacts to barrier beaches and dunes. Efforts to stabilize the Gulf shoreline have adversely impacted barrier landscapes in Louisiana and Texas. Large numbers and varieties of stabilization techniques, such as groins, jetties, and seawalls, as well as artificially-maintained channels and jetties, installed to stabilize navigation channels have been applied along the Gulf Coast. These efforts have contributed to coastal erosion by depriving downdrift beaches of sediments, which accelerates erosion there, and by increasing or redirecting the erosional energy of waves (Morton, 1982). Over the last 20 years, dune and beach stabilization have been better accomplished by using more natural applications such as artificial sand dunes formation, beach nourishment, and vegetative plantings.

Natural Processes

Barrier beaches along coastal Louisiana have experienced severe erosion and landward retreat (marine transgression) because of natural processes enhanced by human activities such as those noted above. Adverse effects on barrier beaches and dunes have resulted from changes to the natural dynamics of water and sediment flow along the coast. This can happen in an attempt to control catastrophic floods and change the natural environment to better accommodate navigation on waterways used to support OCS and non-OCS seaborne traffic. Sea-level rise and coastal subsidence with tropical and extra-tropical storms exacerbate and accelerate the erosion of coastal barrier beaches along the Gulf Coast. Both the western edge of the Louisiana coast and the eastern Texas coast in the WPA received major damage as a result of Hurricanes Katrina, Rita, Gustav, and especially Ike. Texas beaches and barrier islands received the greatest impact from Hurricane Ike. Texas barrier islands and mainland beaches lost elevation and vegetative cover as a result of the erosion accompanying the storm-driven debris and sheer tidal surge. The removal of vegetative cover and scour scars from storm surges also provides an avenue for additional erosion as a result of inlet formations and tidal rivulets. These modifications to island topography may result in hydrological changes that enable further sediment transport from the islands. This provides pathways for further erosion and saltwater intrusion into the less salt-tolerant, interior vegetated habitats on islands. This loss of elevation, combined with the effect of shoreline retreat and removal of vegetation, will continue to allow the expansion of the over wash zone. This reduction in island elevation also results in less frontline protection to valuable marshes within major wildlife refuges like the McFaddin Complex (USDOC, NMFS, 2007a). The reduced elevation of the barrier island and mainland also make urban and industrial areas protected by these marshes and beaches at a higher risk of damage. The reduction in storm protection once provided by barrier islands will result in further conversion of fresh marsh to either open water or salt marsh. Pre- and post-storm studies by University of Texas noted that underwater sand and gravel ridges near the Bolivar inlet were reduced in size and moved landward by Hurricane Katrina and again by Hurricane Gustav (Perkins, 2010). Remnants of these ridges are now located in or adjacent to the Bolivar Inlet, which decreases the depth of the inlet and will require maintenance dredging as a result. The Bolivar Inlet channel was not only reduced in depth but also widened by the erosive forces of the storm surge. This inlet was then eroded to a greater width by the storm surge from Hurricane Ike. Because of these changes and the minimized elevation of underwater dunes, there is a change in the hydrology that once provided the current configuration responsible for sculpting and stabilizing the island. Due to hurricane-induced changes in hydrology, the cumulative effect of additional storms have the potential to further erode barrier islands unless restoration methods are implemented.

Navigation Channels, Vessel Traffic, and Pipeline Emplacements

The effects to coastal barrier beaches and associated dunes from pipeline emplacements, navigation channel use and dredging, and the construction or continued use of infrastructure in support of the WPA proposed action are expected to be restricted to temporary and localized disturbances. The estimated 0-1 pipeline landfalls projected in support of the WPA proposed action are not expected to cause significant impacts to barrier beaches because of the use of nonintrusive installation methods (Chapter 4.2.1.1.3.1 of the Multisale EIS). The estimated 0-1 gas processing plants would not be expected to be constructed on barrier beaches (Chapter 4.2.1.1.3.1 of the Multisale EIS). Existing inland facilities may, through natural erosion and shoreline recession, be located in the barrier beach and dune zone and could contribute to erosion there. The proposed action may contribute to the continued use of such facilities. Maintenance dredging of barrier inlets and bar channels is expected to occur, which when combined with channel jetties generally causes minor and localized impacts on adjacent barrier beaches downdrift of the channel due to sediment deprivation. These impacts would occur whether the proposed action is implemented or not. The proposed action is not expected to adversely alter barrier beach configurations significantly beyond existing, ongoing impacts in localized areas downdrift of artificially jettied and maintained channels. However, due to the effects of recent hurricanes on hydrologic features (e.g., the elimination of underwater sand and gravel ridges noted above), the potential for future erosion of barrier islands is expected to continue. The displacement of these underwater features can potentially increase dredging requirements in the inlets around the Bolivar Peninsula, which in turn lead to increased velocities in the inlets that may increase erosive currents near the barrier islands. The severity of storm effects on these already degraded islands and beaches depends on the frequency and intensity of future storms, and the timely implementation of planned and proposed coastal restoration projects. In addition, inlet maintenance would continue as a result of the cumulative effect of subsequent hurricanes.

The WPA proposed action may extend the life and presence of facilities in eroding areas, which would accelerate localized erosion. The strategic placement of dredged material from channel maintenance, channel deepening, and related actions can mitigate adverse impacts upon those localized areas. With the established importance of barrier islands as frontline protection for both coastal wetlands and mainland infrastructure, there are no current or future plans for routing navigation channels (if needed) through barrier islands.

While vessel traffic to support increased well numbers may also increase over the life of the estimated 40-year period of OCS activities, it is doubtful that an overall increase would continue since some older wells would be coming out of service as new wells come into service. This being the case, there should not be a sustainable cumulative increase in the need for supply and support vessels. This is because vessel traffic would either decrease or reach a state of equilibrium to meet the needs of the working wells. The entire current 5-Year Program accounts for only 12 percent of the commercial ship traffic. The WPA proposed action is now estimated to account for 1-2 percent (calculated from Table 4-4 of the Multisale EIS and **Table 3-2** of this Supplemental EIS) of the service-vessel traffic of the current 5-Year Program. Further details concerning vessel traffic can be found in Chapters 4.2.1.1.3.1 and 4.1.1.8.4 of the Multisale EIS.

Oil Spills

Sources and probabilities of oil entering waters of the Gulf and surrounding coastal regions are discussed in Chapter 4.1.3.4 of the Multisale EIS. Inland spills that do not occur in the vicinities of barrier tidal passes are more likely to contact the landward rather than the ocean side of a barrier island. Hence, no inland spills are expected to significantly contact barrier beaches (Chapter 4.2.1.1.3.1 of the Multisale EIS).

Most spills occurring in offshore coastal waters are assumed to proportionally weather and dissipate before hitting the Texas coast, as described in Table 4-37 of the Multisale EIS. Dispersants are not expected to be used in coastal waters. However, for offshore spills, the dispersal of about 65 percent of the volume of a spill is attributed to the use of dispersants. No calculation has been made to estimate how much oil might be deposited on a beach if dispersants are not used. Unfavorable winds and currents would further diminish the volume of oil that might contact a beach. A persistent, northwesterly wind might preclude contact. As discussed in Chapters 3.2.1.1 and 4.5.3.1 of the Multisale EIS, the probability that tide levels could reach or exceed the elevations of sand dune vegetation on barrier beaches ranges from 0 to 16 percent. This depends on the particular coastal setting and the elevation of the vegetation. The strong winds that would be needed to produce unusually high tide levels would also disperse the slick over a larger area than is considered in the current analysis. The probabilities of spill occurrence and contact to barrier beaches and sand-dune vegetation are considered low. Hence, contact of sand-dune vegetation by spilled oil is not expected to occur. The mixing would reduce the oil concentrations contacting the beach and vegetation, greatly reducing impacts on vegetation.

In the case of Texas, the barrier islands are close to the mainland and under normal conditions have a greater potential of being affected by inland and nearshore spills than offshore spills. Due to the distant proximity of these islands and beaches from producing offshore wells, the DWH event had little detectable effect on the Texas beaches and barriers. Weather, sea conditions, currents, and timely response efforts to this large-scale spill greatly reduced the risk of oil reaching the shores of Texas. However, the reduction in slope on the beach face, loss of dune elevation, and development of scour inlets resulting from past hurricane activity contribute to future vulnerability of the once protected coastal inland habitats from oil spills. The barrier and mainland beaches will continue to be susceptible to spills associated vessel collisions, pipeline breaks, and refinery accidents near or at transfer facilities by the ports of Houston and Beaumont. Hurricane Ike resulted in numerous oil spills along the Texas coast. The largest effects were along the Bolivar Peninsula where the storm came ashore. There were also over 202 ha (500 ac) of Federal refuges affected by Ike-related oil spills. Other refuges such as Bessie Heights Marsh and Murphree Wildlife Management Area had from 486 to 809 ha (1,200 to 2,000 ac) affected by oil sheens and some physical oilings (Texas Parks and Wildlife Department, 2008). Future spills that would affect these areas are possible as refinery and offshore production facilities and pipelines continue to age and become more vulnerable to storm and hurricane damage. The average age of production facilities and pipelines in the Gulf is approximately 20 years, with some platforms still in production after 60 years (Casselman, 2010). Most of the hurricane-related spills resulted from storm damage to older pipelines and other aging infrastructure. Past studies have shown that there is a direct relationship between older offshore production facilities and the potential for accidents and spills (Pulsipher et al., 1998). It is expected that, in the future, more of these facilities would be taken out of production or be replaced as new infrastructure is brought on line. With the placement of new infrastructure, combined with the continual updating of safety regulations and programs, it is expected future spills would be greatly reduced.

If spills should occur, the results of an investigation on the effects of the disposal of oiled sand on dune vegetation in Texas showed no deleterious impacts on the existing vegetation or on the colonization of the sand by new vegetation (Webb, 1988). Hence, projected oil contacts to small areas of lower elevation sand dunes are not expected to result in destabilization of the sand dune area or the barrier landform.

Most of the Texas coast is comprised of sandy beaches with little vegetation directly on the beach head, and the more vulnerable wetland vegetation is located behind the dune or beach systems where they are less likely to come in contact with spilled oil. Beach cleanup techniques involving heavy machinery can drive oil farther into the sediment; however, the new machinery allows the sand to be sifted in place and returned to the beach after the oil is removed. Some oil may penetrate to depths beneath the reach of the cleanup methods. The remaining oil would persist in beach sands, periodically being released when storms and high tides resuspend or flush through beach sediments. During hot, sunny days, tarballs buried near the surface of the beach sand may liquefy and cause a seep to the sand surface. The long-term stressors, including physical effects and chemical toxicity of hydrocarbons, may lead to decreased primary production, plant dieback, and hence further erosion (Ko and Day, 2004b).

This analysis assumes that Texas would require the responsible party to clean the beach without removing significant volumes of sand or to replace the sand removed. Therefore, cleanup operations are not expected to cause permanent effects on barrier beach stability. Within a few months, adjustments in beach configuration may result from the disturbance and movement of sand during clean up.

Recreational Use and Tourism

Most barrier beaches in the WPA are accessible to people for encouraged recreational use because of public road access. The Texas Open Beaches Act of 1959 guarantees the public's right to unimpeded use of the State's beaches. It also provides for public acquisition of private beachfront property. Recreational use of barrier beaches and dunes can have impacts on the stability of the landform. Vehicle and pedestrian traffic on sand dunes can stress and reduce the density of vegetation that binds the sediment and stabilizes the dune. Destabilized dunes are more easily eroded by winds, waves, and traffic. Judd et al. (1988) documented that as much as 18 percent of the total dune area along parts of South Padre Island, Texas, had experienced damage from vehicular traffic. Recreational vehicles and even hikers have been problems where road access is available and the beach is wide enough to support vehicle use. Areas without road access would have limited impacts by recreational vehicles. Hurricane Ike heavily impacted both the highly developed beaches along the Bolivar Peninsula along with the recreational areas associated with State and Federal wildlife management areas and refuges. Currently, these areas are being restored through programs associated with the Texas Coastal Erosion Planning and Response Act. These actions are being coordinated with State and Federal resource agencies to assure redevelopment is compatible with the environmental functions of these sensitive beaches and wetlands. Dune restoration and installation projects along the hard-hit McFaddin Beach are underway with beach nourishment projects along South Padre and Rollover islands (Texas General Land Office, 2007). These and other projects planned for shoreline protection and wetland restoration under the Texas Coastal Erosion Planning and Response Act and the BOEMRE Coastal Impact Assistance Program are expected to continue to mitigate the loss of these sensitive environments in the future. The WPA proposed action would not provide any additional access that would result in increased negative cumulative impact to the barrier beaches and dunes.

Summary and Conclusion

River channelization, sediment deprivation, tropical and extra-tropical storm activity, sea-level rise, and rapid submergence have resulted in severe, rapid erosion of most of the barrier and shoreline landforms along the Louisiana coast. The Texas coast has experienced landloss because of a decrease in the volume of sediment delivered to the coast because of dams on coastal rivers, a natural decrease in sediment supply as a result of climatic changes during the past several thousand years, and subsidence along the coast. Storm-induced changes in hydrology have, in some cases, changed the current regime responsible for stabilizing the barrier islands. Beach stabilization projects are considered by coastal geomorphologists and engineers to accelerate coastal erosion. Beneficial use of maintenance dredged materials and other restoration techniques could be required to mitigate some of these impacts.

The impacts of oil spills from both OCS and non-OCS sources to the Texas coast should not result in long-term alteration of landform, if the beaches are cleaned using techniques that do not significantly remove sand from the beach or dunes. Barrier beaches in the region around Galveston have the greatest risks of sustaining impacts from oil-spill landfalls because of the high concentrations of oil production near that coast. However, the majority of inshore spills are assumed to be small in scale (historical data indicate they average 5 bbl; Table 4-13 of the Multisale EIS) and short in duration; therefore, impacts would be minor. Oil from most offshore spills is expected to be weathered and dissipated by the time it would contact coastal beaches. The cleanup impacts of these spills could result in short-term (up to 2 years) adjustment in beach profiles and configurations as a result of sand removal and disturbance during the cleanup operations. Some contact to lower areas of sand dunes is expected. These contacts would not result in significant destabilization of the dunes. All cleanup efforts would be monitored to ensure the least amount of disturbance to the areas. The long-term stressors to barrier beach communities caused by the physical effects and chemical toxicity of an oil spill may lead to decreased primary production, plant dieback, and further erosion.

Under the cumulative scenario, new OCS-related and non-OCS pipeline landfalls are projected. These pipelines are expected to be installed using modern techniques, which cause little to no impacts to the barrier islands and beaches. Existing pipelines, in particular those that are parallel and landward of beaches, that had been placed on barrier islands using older techniques that left canals or shore protection structures have caused and would continue to cause barrier beaches to narrow and breach.

Recreational use of many barrier beaches in the WPA is intense due to their accessibility by road. These activities can cause changes to the beach landscapes. There are ongoing restoration efforts to minimize damages to beaches from both natural and human impacts.

In conclusion, coastal barrier beaches have experienced severe adverse cumulative impacts from natural processes and human activities. Natural processes are generally considered the major contributor to these impacts, whereas human activities cause severe local impacts and accelerate the natural processes that deteriorate coastal barriers. Human activities that have caused the greatest adverse impacts are river channelization and damming, pipeline canals, navigation channel stabilization and maintenance, and beach stabilization structures. Deterioration of Gulf barrier beaches is expected to continue in the future. Federal, State (Texas), and county governments have made efforts through the Texas Coastal Erosion Planning and Response Act program and CZM programs to restore or protect the sensitive and vulnerable barrier islands and mainland beaches.

The WPA proposed action is not expected to adversely alter barrier beach configurations significantly beyond existing, ongoing impacts in localized areas downdrift of artificially jettied and maintained channels. The proposed action may extend the life and presence of facilities in eroding areas, which would accelerate erosion in those areas. Strategic placement of dredged material from channel maintenance, channel deepening, and related actions could mitigate adverse impacts upon those localized areas. The proposed action is not expected to increase the probabilities of oil spills beyond the current estimates. Thus, the incremental contribution of the proposed action to the cumulative impacts on coastal barrier beaches and associated dunes is expected to be small.

4.1.1.4. Wetlands

The BOEMRE has reexamined the analysis for wetlands presented in the Multisale EIS and the 2009-2012 Supplemental EIS (addition of 181 South Area), based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusion for wetlands presented in the Multisale EIS or the 2009-2012 Supplemental EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS. A summary of those analyses and their reexamination due to new information and in consideration of the DWH event is presented in the following sections. A brief summary of potential impacts follows. Effects to coastal wetlands from the primary impact-producing activities associated with the WPA proposed action are expected to be low. The primary impact-producing activities associated with routine activities for the proposed action that could affect wetlands include pipeline emplacement, construction and maintenance, navigational channel use (vessel traffic) and maintenance, disposal of OCS-related wastes, and use and construction of support infrastructure in these coastal areas. Vessel traffic associated with the proposed action is expected to contribute minimally to the erosion and widening of navigation channels and canals. Deltaic Louisiana is expected to continue to experience the greatest loss of wetland habitat. Wetland loss is also expected to continue in coastal Texas, Mississippi, Alabama, and Florida, but at slower rates. The incremental contribution of the proposed action to the cumulative impacts on coastal wetlands is expected to be very small.

Routine activities in the WPA such as pipeline emplacement, navigational channel use, maintenance dredging, disposal of OCS wastes, and construction and maintenance of OCS support infrastructure in coastal areas are expected to result in low impacts. Indirect impacts from wake erosion and saltwater intrusion are expected to result in low impacts, which are indistinguishable from direct impacts from inshore activities. The potential impacts from accidental events, primarily oil spills, are anticipated to be minimal. The incremental contribution of the proposed action's impacts to the cumulative impacts to wetlands is small and expected to be negligible.

The wetlands in the WPA have been affected either directly or indirectly by the successive large-scale hurricanes (Katrina, Rita, Gustav, and Ike) over the past 6 years. Hurricane Alex only marginally affected Texas with massive amounts of rain. The Macondo well was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). Since the WPA wetlands are located even farther west than the westernmost extent of the sheen related to the DWH event, and that they are located behind coastal barrier islands and beaches which protect them, there have been no observable impacts to WPA wetlands related to the DWH event.

4.1.1.4.1. Description of the Affected Environment

A detailed description of various wetland types, processes, functions, and importance can be found in Chapter 3.2.1.2 of the Multisale EIS and in Chapter 4.1.3.2.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

According to the U.S. Dept. of the Interior (Dahl, 1990; Henfer et al., 1994), during the mid-1980's, 4.4 percent of Texas (3,083,860 ha) (Henfer et al., 1994) was considered wetlands. One of the important functions of coastal marshes and barrier islands is as a frontline of defense against storm surge.

High organic productivity and efficient nutrient recycling are characteristic of coastal wetlands. They provide habitat for a great number and wide diversity of resident plants, invertebrates, fishes, reptiles, birds, and mammals. Marsh environments are particularly important nursery grounds for many economically important fish and shellfish juveniles. The marsh edge, where marsh and open water come together, is particularly important for its higher productivity and greater concentrations of organisms. Emergent plants produce the bulk of the energy that supports salt-marsh dependent animals. Freshwater-marsh environments generally contain a much higher diversity of plants and animals than do those of saline marshes.

Wetland habitats found along the Texas Gulf Coast include fresh, intermediate, brackish, and saline marshes; mud and sand flats; and forested wetlands of mangrove swamps, cypress-tupelo swamps, coastal flatwoods, and bottomland hardwoods. Coastal wetland habitats occur as bands around waterways and as broad expanses. Saline and brackish habitats support sharply delineated, segregated stands of single plant species. Fresh and very low salinity environments support more diverse and mixed communities of plants. The plant species that occur in greatest abundance vary greatly around the Gulf. For those reasons, interested readers are referred to ecological characterization and inventory studies conducted by the FWS, in cooperation with other agencies; the Texas Bureau of Economic Geology; and other researchers (Gosselink et al., 1979; Smith, 1984; Fisher et al., 1972 and 1973; Brown et al., 1976 and 1977; Stout et al., 1981; Texas Parks and Wildlife Department, 2003).

Along the Texas coast estuarine or tidal fringe wetlands can be vegetated (marshes) or unvegetated (mud and sand flats) and are found between the open saltwater of the bays or Gulf and the uplands of the coastal plain and barrier islands. These wetlands may occur in small strips just 10-20 ft (3-6 m) wide or may be several miles wide and occupy thousands of acres. Marshes are almost always in protected areas along bay shorelines or on the bay sides of barrier islands and peninsulas (Texas Parks and Wildlife Department, 2003). Salt marshes are flooded by tides and their salinity and plant communities depend upon how much fresh water is delivered to the wetlands by the rivers that flow into the bays. The high marsh is only irregularly flooded by tides and may go for extended periods without flooding. The low marsh, however, is subject to regular flooding, at least once a day. Cordgrasses of the *Spartina* genus are the most prominent salt-marsh vegetation. Flooding frequency, duration, and the salinity level are the most important variables that control the kinds of plants that occur in the salt marsh. In the high marsh, saltmeadow cordgrass might be the most common grass, whereas in the lower marsh, saltmarsh cordgrass is more common. Additional vegetation includes saltgrass, saltmarsh bulrush, and needlegrass rush among others. Since the mid-1950's, the area of salt and brackish marshes on the Texas coast has decreased by more than 8 percent; a net loss of more than 31,000 ac (12,545 ha) (Texas Parks and Wildlife Department, 2003).

Texas Barrier Islands and Tamaulipas Coastal Wetlands

Landward of the barrier beaches of Texas, estuarine marshes largely occur as continuous and discontinuous bands around bays, lagoons, and river deltas. The troughs created between the dune systems on the barrier islands receive freshwater runoff from the adjacent dunes as well as elevated fresh groundwater that floats on the top of the saltwater as sea level rises (Texas Parks and Wildlife Department, 2003). Freshwater wetlands are found in these interdunal swales and on larger interior wind-eroded flats on the barrier islands that line the Texas coast. The wetland plants found in these interdunal fresh areas are similar to those found in other freshwater marshes, but they may include some brackish-water species due to elevated soil salinity in some areas. Typical species include saltmeadow cordgrass, southern cattail, bulrushes, coastal water-hyssop, coastal plain pennywort, spikerushes, flatsedges, sedges, burhead, marsh fimbry, white-topped sedge, frogfruit, coffee bean, seashore paspalum, bushy bluestem, and other grasses.

Tidally influenced wetlands on the bay margins of the islands are included with the Tidal Fringe wetlands. Broad expanses of emergent wetland vegetation do not commonly occur south of Baffin Bay because of the arid climate and hypersaline waters. In the vicinity of southern Padre Island, marshes are minimal and unstable compared with the more northern Gulf. In Tamaulipas, Mexico, marshes behind the barrier islands are even less abundant than seen in the vicinity of Padre Island. Dominant salt-marsh plants in southern regions include more salt-tolerant species such as turtleweed (*Batis maritime)* and glasswort (*Salicornia* sp.).

Brackish marshes occur in less saline, inland areas and are divided into frequently and infrequently flooded marshes. Infrequently flooded marshes contain an assemblage of plants that are much more tolerant of dry conditions. Freshwater marshes in Texas occur inland above tidally delivered saline waters, in association with streams, lakes, and catchments. Broken bands of black mangroves (*Avicennia germinans*) also occur in this area (Brown et al., 1977; White et al., 1986).

Wind-tidal flats of mud and sand are mostly found around shallow bay margins and in association with shoals. As one goes farther south from Corpus Christi and into Tamaulipas, flats increasingly replace lagoonal and bay marshes. The Laguna Madre of Texas is divided into northern and southern parts by the wind-tidal flats of the Land-Cut Area, just south of Baffin Bay.

Inland beaches of sand and shells are found along the shores of bays, lagoons, and tidal streams. The structure of these beaches is similar to, but much narrower and smaller in scale than, barrier beaches. Compared with the sand beaches, shell features are typically stacked to higher elevations by storm waves and are generally more stable.

Few freshwater swamps and bottomland hardwoods occur in the general vicinity of OCS-related service bases and navigation channels of the Texas barrier island area. In the southern third of this area, they are nonexistent (Brown et al., 1977; White et al., 1986).

Chenier Plain

The Chenier Plain is a unique salt marsh area on the extreme eastern edge of the Texas Gulf Coast and is part of a much larger Chenier Plain in western Louisiana. A Chenier Plain is a series of sandy or shelly ridges or "cheniers," many more than 10 ft (3 m) high, separated by clayey or silty marsh deposits. The distance from chenier to chenier may be as much as 1 or 2 mi (1.6 or 3.2 km) or more. The Texas Chenier Plain started to form about 3,000 years ago when the mouth of the Mississippi River shifted to the west, bringing an increase in sediment to southwestern Louisiana and extreme southeast Texas. These sediments built marshes out into the Gulf. During periods of low sediment input, wave action reworked the Gulf-facing sediments into ridges or cheniers, until the next pulse of sediment built marsh farther out into the Gulf again, resulting in the characteristic series of ridges (Texas Parks and Wildlife Department, 2003). The current portion of the Texas Chenier Plain is located between Port Bolivar, Texas, and Atchafalaya Bay in Louisiana. As the area filled in, a series of shell and sand ridges were formed parallel or oblique to the present-day Gulf Coast and were later abandoned as sea level continued to fall. Mudflats formed between the ridges when localized hydrologic and sedimentation patterns favored deposition there. This intermittent deposition isolated entrenched valleys from the Gulf, forming large lakes such as Sabine, Calcasieu, White, Grand, and others (Gosselink et al., 1979; Fisher et al., 1973). As a result, few tidal passes are found along this coast as compared with central Texas and eastern Louisiana. This reduces the tidal movement of saline waters. The mouth of the Mississippi River has shifted repeatedly during the last 3,000 years, causing alternating slow beach deposition and rapid marsh building into the Gulf. In this way, the once broad bay of the Sabine and Neches Rivers was cut off from the Gulf by the deposition of the Chenier Plain wetlands. Wetlands in the low areas between the beach ridges are estuarine salt and brackish marshes connected by tidal channels to Sabine Pass.

Because of the structure of the Chenier Plain and its beaches, salt marshes are not as widely spread there as elsewhere in the northern Gulf. Generally in this area, salt marshes front the Gulf directly and are frequently submerged by tides and storms. Hence, they are considered high-energy environments, as compared to most vegetated wetlands. Brackish and intermediate salinity marshes are dominant in estuarine areas of the Chenier Plain. They are tidal, although wind-driven tides are more influential and occasionally inundate these areas. Since salinity in this area ranges broadly, these habitats support a mix of salt and salt-tolerant freshwater plants, although marsh-hay cordgrass is generally dominant. These habitats are the most extensive and productive in coastal Louisiana.

Plant communities of freshwater marshes are among the most diverse of sensitive coastal environments. Annuals have a much greater presence in freshwater marshes than in estuarine areas. Dominance often changes from season to season as a result of year-round, seed-germination schedules. Freshwater wetlands are extensive in the Chenier Plain due to the abundant rainfall and runoff, coupled with the ridge system that retains freshwater and restricts the inflow of saline waters. Tidal influences are generally minimal in these areas, although strong storms may inundate the area. Hence, detritus is not as readily exported and accumulates there, supporting additional plant growth. Freshwater marsh plants are generally more buoyant than estuarine plants. In areas where detritus collects thickly, marsh plants may form floating marshes, referred to as "flotants." Flotants generally occur in very low-energy environments. They are held together by surrounding shorelines and a weave of slowly deteriorating plant materials and living roots.

The coastal flatwoods occur on the poorly drained flats between coastal rivers but, unlike bottomland hardwoods, they do not receive or depend on river overflow for their water supply. These flatwoods are located in areas where rainfall is captured and the soil characteristics promote slow runoff. The flatwoods wetlands stretch from the Louisiana border west to about the Houston area, and they are extensive. These forest assemblages tend to be located between rivers and streams on the upper Texas coast. The coastal flatwoods are dominated by either pine or hardwoods. Common trees of the drier pine wet flatwoods are longleaf, shortleaf, and loblolly pines. The wetter hardwood flatwoods include willow and laurel oaks, swamp chestnut oak, cherrybark oak, and sweetgum, with dwarf palmetto common in the understory. The southern extension of the Piney Woods region of East Texas once was occupied by poorly drained, longleaf pine woodlands that extended south into eastern Harris County. This community was a matrix of beakrushes, sedges, and grasses with scattered longleaf pines and was maintained by frequent burning. As fire was suppressed by humans, trees and shrubs like black tupelo, sweetgum, wax-myrtle, and yaupon increased. Loblolly pine is now dominant and has been favored by the commercial timber industry. The hardwood flatwoods occur on the coastal prairies and marshes region of the upper coast. The suppression of fire may have favored hardwoods in some areas that were longleaf pine savanna.

As previously noted, the existing coastal landscape has now been altered by a series of powerful hurricanes that have changed the current condition and sometimes functions of the wetland resources along the Texas and Louisiana coasts. Hurricane Rita made landfall in September 2005 along the Texas/ Louisiana coast. It may be years before the full extent of impacts is known. Most of the wetlands along the Texas coast are associated with the national wildlife refuges and State wildlife management areas, such as Texas Point National Wildlife Refuge, McFaddin National Wildlife Refuge, Sea Rim State Park, and J.D. Murphree State Wildlife Management Area. These areas comprise the McFaddin Complex and contain over 60,000 ac (24,280 ha) of coastal marsh (fresh, intermediate, and brackish) coastal prairie (nonsaline and saline), coastal woodlands, and beach/ridge habitat in Jefferson and Chambers Counties in southeast Texas. The ridge/dune system that was the main buffer between the Gulf and the wetlands has been significantly lowered by the overwash of the past hurricanes. While a remnant dune/beach system still exists post-Hurricane Rita, much has been lost through erosion and shoreline retreat, leaving only a low-lying washover terrace. Loss of the existing beach dunes and the lowering of beach ridge elevations along the Gulf shoreline of the McFaddin Complex from Hurricane Rita imperils approximately 30,000 ac (12,140 ha) of nationally significant wetlands due to the increasing frequency of saltwater inundation from the Gulf of Mexico. Ongoing shoreline retreat along the Gulf of Mexico, which was exacerbated by Hurricane Rita, is resulting in a rapid loss of valuable coastal habitats, including emergent estuarine marshes and coastal prairies.

In summary, the national wildlife refuges in southeast Texas suffered wetland habitat loss, primarily as a result of wave erosion, during Hurricane Rita. Impacts to three Federal refuges were estimated to include direct marsh loss of more than 75 ac (33 ha), approximately 15,000 ac (6,070 ha) of marsh under increased threat by future storms, and erosion losses along 20 mi (32 km) of shoreline. Following Hurricanes Katrina and Rita, two additional hurricanes (Gustav and Ike) made landfall on the Gulf Coast. While Louisiana received most of the damage from Hurricane Gustav, the Texas coast endured the brunt of Hurricane Ike, which made landfall slightly east of Galveston. The resulting 13- to 15-ft (4- to 5-m) storm surges washed over the elevated western coastline of Texas from High Island westward across the Bolivar Peninsula to the west side of Galveston Island. The storm surge basically removed the dune systems and significantly lowered the beach elevations along this portion of the Texas coast. The erosion and washover associated with Hurricane Ike's tidal surge breeched beach ridges, opening the inland freshwater ponds and their associated wetlands to the sea.

As a result of the four successive storms, the Louisiana and Texas coasts have lost protective elevations, barrier islands, and wetlands, and they now have the potential for transitioning to a less productive salt-marsh system in areas where fresh-marsh systems once existed. State and Federal Governments are currently implementing coastal restoration projects, including freshwater and sediment diversions, beach restorations, marsh building, and restoration through several programs such as CWPPRA and CIAP.

The Laguna Madre

The Laguna Madre of Texas is divided into northern and southern parts by the wind-tidal flats of the Land-Cut Area, just south of Baffin Bay. The Intracoastal Waterway is dredged through this area, as are a series of well access channels. Dredging has caused topographic and vegetative changes among the flats of Laguna Madre. The Laguna Madre is the very salty lagoon that supports the estuarine wetlands of the lower Texas coast. The lower coast has extensive estuarine wetlands, but the area is basically very dry and is not supportive of the lush emergent marshes of the humid upper coast. Saltwort, glassworts, saltgrass, keygrass, seapurslane, sea-oxeye, and a few other plants dominate the limited emergent salt marshes fringing the Laguna. Saltmarsh cordgrass is only a minor component of lower coast salt marshes.

Fringing the Laguna Madre are broad, nearly unvegetated wind-tidal salt flats. These sandy flats are not regularly flooded by tides. They are only occasionally flooded when strong winds push shallow water from the Laguna onto the low flats. The cycle of irregular flooding and drying causes salt to build up on the surface of the flats. These salt flats are inhospitable to most vascular plants but are often covered by vast mats of blue-green algae. Frequently flooded flats usually remain moist and may have mats of blue-green algae and an area-specific assemblage of invertebrates. Infrequently flooded flats are at higher elevations where only tides that are driven by strong wind can flood them. These are better drained and much dryer. Higher tidal flats remain barren because of the occasional saltwater flooding and subsequent evaporation that raises salt concentrations in the soil. This inhibits most plant growth; some salt-marsh plants that are tolerant of dry conditions may be found there. Some higher flats are nontidal, barren fan deltas and barren channel margins along streams. The salt concentrations of these soils are often elevated also (Brown et al., 1977; White et al., 1986). These habitats may look barren, but they support rich invertebrate populations that, in turn, attract large numbers of shorebirds and wading birds.

The black mangrove is a tropical species and forms shrub wetlands in the intertidal fringe of the Laguna Madre. Four species of tropical mangroves occur around the Gulf of Mexico, but only black mangrove is found north of the Rio Grande. Mangrove wetlands can be seen along the causeway between Port Isabel and South Padre Island, and fringing South Bay, just south of the Brownsville Ship Channel near Brazos Santiago Pass. Mangroves also occur near Harbor Island in Aransas Bay near Aransas Pass (Texas Parks and Wildlife Department, 2003).

4.1.1.4.2. Impacts of Routine Events

Background/Introduction

A detailed description of routine impacts from the WPA proposed action to wetlands is given in Chapter 4.2.1.1.3.2 of the Multisale EIS and in Chapter 4.1.3.2.2 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

This section considers impacts from routine activities associated with the WPA proposed action to coastal wetlands and marshes. The primary impact-producing activities associated with the proposed action that could affect wetlands and marshes include 0-1 pipeline emplacements, possible channel maintenance and construction, disposal of OCS-related wastes, increased vessel traffic, the use and construction of support infrastructure in these coastal areas. Other potential impacts that are indirectly associated with OCS oil and gas activities are wake erosion resulting from navigation traffic and additional onshore development encouraged by increased capacities of navigation channels.

Impacts from the WPA proposed action to coastal wetlands and marshes would occur primarily in Texas. The Texas Gulf Coast is comprised of a broad range of saline, brackish, intermediate, and freshwater wetlands. These include wet prairies, forested wetlands, barrier islands, mud flats, and riparian wooded areas. Saline and brackish marshes are most widely distributed south of the Galveston Bay area, while intermediate marshes are the most extensive marsh type northeast of Galveston Bay. The most extensive wetlands along the Texas coast are located in the Strandplain-Chenier Plain System that runs from eastern Chambers County, Texas, through Vermilion Parish, Louisiana.

In 1955, Texas had an estimated 4.1 million ac (1.7 million ha) of coastal wetlands. Of these, about 84.6 percent (1.4 million ha; 3.5 million ac) were freshwater palustrine, 15.3 percent (253,409 ha; 626,188 ac) were saltwater estuarine, and 0.1 percent (166,137 ha; 410,534 ac) were marine intertidal. There were also 1,664,698 ac (673,679 ha) of deepwater habitats consisting of rivers (23,999 ha; 59,303 ac), reservoirs (27,334 ha; 67,544 ac), and estuarine subtidal bays (622,346 ha; 1.5 million ac). However, in 1992, an estimated 1.6 million ha (3.9 million ac) of wetlands existed. The ratio of wetland habitats was similar, with 85.3 percent palustrine, 14.5 percent estuarine, and 0.1 percent marine. There was more open-water acreage, with 728,434 ha (1.8 million ac). These include rivers with 24,345 ha (60,159 ac), reservoirs with 59,636 ha (147,363 ac), and estuarine bays with 627,292 ha (1.6 million ac). Areas with the greatest wetlands concentration appeared to be in Jefferson, Liberty, and Chambers Counties. Substantial acreage also existed in Orange, Brazoria, Fort Bend, Wharton, Matagorda, Jackson, Calhoun, and Kenedy Counties (Moulton et al., 1997). Wetland concentrations in these areas did not change significantly between 1955 and 1992. Hurricanes Katrina, Rita, and Ike increased erosion of beaches and wetlands along the Texas coast, causing still unquantified losses in marsh.

Pipeline Emplacement

Where a pipeline crosses the shoreline is referred to as a pipeline landfall. Many OCS pipelines make landfall on Texas' barrier island and wetland shorelines. Approximately 8,000 km (4,971 mi) of OCS-related pipelines cross marsh and uplands (Johnston et al., 2009). Wetlands protect pipelines from waves and ensure that the lines stay buried and in place (**Chapter 3.1.2.3**). Existing pipelines have caused direct landloss averaging 2.5 ha/km (10 ac/mi) (Bauman and Turner, 1990). Bauman and Turner (1990) indicated that the widening of OCS pipeline canals does not appear to be an important factor for total net wetland loss in the coastal zone because few pipelines canals are open to navigation. Historically, a major concern associated with pipeline construction through wetlands was disturbance caused by backfilling. Pipeline canals were backfilled with the original dredged materials. The major factors determining the success of backfilling as a means of restoration are the canal depth, dimensions, locale, soil type, dredge-operator skill, and permitting conditions (Turner et al., 1994). Generally, plugging the canal has no apparent effect on water depth or vegetation cover. There is one exception where submerged aquatic vegetation was more frequently observed behind backfilled canals with plugs than in backfilled canals without plugs. Canal length and percentage of backfill returned have the greatest effect on the recovery of vegetation (Turner et al., 1994). While investigating backfilling canals as a wetland restoration technique in coastal Louisiana, Turner et al. (1994) discovered that canals backfilled as mitigation for offsite dredging are typically shallower if they are older or in soils lower in organic matter. Vegetation recovery increases with increased canal length and percentage of material returned. In areas where soils have high organic content (e.g., deltaic plains and the Chenier Plain), backfilling does not usually fill a canal completely, which may result in conversion to an open-water habitat

The loss of wetland habitat is difficult to determine because it depends on the pipeline emplacement technique used, amount of backfilling, time of year, and duration of construction. After pipelines are constructed and backfilled in Texas wetlands, a shallow channel is expected to remain where the canal passes through the wetland. In the coastal areas of Louisiana, some open-water areas may remain. Approximately 6 years after backfilling has occurred, productivity of vegetation in areas directly over the pipeline is expected to be reduced. It is estimated that wetland habitat could be reduced by as much as 25 percent in Texas from pipeline activities. For the same period of time (approximately 6 years), productivity of wetland vegetation that flanks a pipeline is expected to be reduced as much as 11 percent in Texas. Modern pipeline emplacement techniques, such as avoidance of wetlands areas and directional boring under wetlands, result in zero to negligible impacts of pipeline activities to wetlands.

The BOEMRE is presently conducting a study in conjunction with USGS's Biological Resource Division to investigate coastal wetland impacts from the widening of OCS-related canals rates and the effectiveness of mitigation. Prior to this study, there were no known studies addressing the effectiveness or longevity of canal-related mitigation. Also, BOEMRE is currently identifying and mapping onshore OCS-related pipelines in the coastal regions around the Gulf. These include pipelines in wetland habitats in Kenedy, Aransas, Calhoun, Matagorda, Brazoria, Galveston, and Orange Counties, Texas. With the OCS pipelines identified, this study will provide basic information for environmental impact assessments and for mitigation development by BOEMRE and other Federal agencies.

Dredging

No new navigation channels are expected to be dredged as a result of the WPA proposed action. An increase in OCS deepwater activities, which require larger service vessels for efficient operations, is expected in the long term. This may shift some deepwater support activities to shore bases associated with deeper channels. Some of the ports that have navigation channels that can presently accommodate deeper-draft vessels may expand port facilities to accommodate these deeper-draft vessels (e.g., Port of Galveston, Texas).

Dredging and dredged-material disposal can be detrimental to coastal wetlands and associated fish and wildlife that use these areas for nursery grounds, protection, etc. Periodic maintenance dredging of navigation channels results in additional deposits material on existing disposal banks. The effects of dredged-material disposal banks from the proposed action on wetland drainage is expected to continue unchanged, except if there are some localized and minor aggravations of existing problems. For example, some material intended for placement on a dredged-material disposal bank is placed in adjacent wetlands or shallow water. Wetland loss due to dredge material deposition is expected to be offset by wetland creation as adjacent margins of shallow water are filled. Maintenance dredging would also temporarily increase turbidity levels in the vicinity of the dredging and disposal of materials, which can impact emergent wetlands and submerged vegetation communities.

Two methods are generally used to dredge and transport sediments from channels to open-water sites: (1) hydraulic cutterhead suction dredge transfers sediments via connecting pipelines and (2) clamshell bucket dredge transfers sediments via towed bottom-release scows. Each method produces a distinctly different deposit. Hydraulic dredging creates a slurry of sediment and water, which is pumped through a pipeline to the dredged material disposal site. Coarser sediment settles to the bottom where it spreads outward under the force of gravity, and finer sediments may remain in suspension longer. The clamshell dredge scoops sediments relatively intact into scows, which are then towed to the designated area. The dredged sediments are released into the area specified for disposal. This method usually produces positive relief features in the placement area.

Access canals, as well as pipeline canals, are commonly bordered by levees created using dredged material (Rozas, 1992). Placement of this material alongside canals converts low-lying marsh to upland, an environment unavailable to aquatic organisms except during extreme high tides. Dredged material can also form a barrier, causing ponding behind levees and limiting circulation between canal waters and marshes to infrequent, high-water events (Swenson and Turner, 1987; Cox et al., 1997). This and similar disruptions to marsh hydrology are believed to change coastal habitat structure as well as accelerate marsh erosion and conversion to open water (Turner and Cahoon, 1988; Rozas, 1992; Turner et al., 1994; Kuhn et al., 1999).

Executive Order 11990 requires that material, where appropriate, from maintenance dredging be considered for use as a sediment supplement in deteriorating wetland areas to enhance and increase wetland acreage. Disposal of dredged material for marsh enhancement has been done only on a limited basis. Given the COE‘s policy of beneficial use of dredge, increased emphasis has been placed on the use of dredged material for marsh creation. For the proposed action, increased use of dredged material to enhance wetland habitats is encouraged as mitigation.

Navigation Channels and Vessel Traffic

Vessel traffic that may support the proposed action is discussed in Chapter 4.1.1.8.4 of the Multisale EIS, Chapter 3.1.1.4 of the 2009-2012 Supplemental EIS, and **Chapter 3.1.2** of this Supplemental EIS. Most navigation channels projected to be used to support the WPA proposed action are shallow and are currently used by vessels that support the OCS Program (Chapter 4.1.2.1.9 and Table 3-36 of the Multisale EIS). Waves generated by boats, ships, barges, and other vessels erode unprotected shorelines and accelerate erosion in areas already affected by the natural erosion process as evident along the Texas coast. There, heavy traffic using the Gulf Intracoastal Waterway has accelerated erosion of existing salt marsh habitat (Cox et al., 1997). According to Johnson and Gosselink (1982), canal widening rates in coastal Louisiana range from about 2.58 m/yr (8.46 ft/yr) for canals with the greatest boat activity to 0.95 m/yr (3.12 ft/yr) for canals with minimal boat activity. This study found navigational use is responsible for an average of 1.5 m/yr (4.9 ft/yr) of the canal widening. Approximately 3,200 km (1,988 mi) of OCS-related navigation canals, bayous, and rivers are found in the coastal regions around the Gulf. This is exclusive of channels through large bays, sounds, and lagoons. About 700 km (435 mi) of these channels support OCS-related activities in the WPA. Total navigational use (OCS and non-OCS) results in about 105 ha (259 ac) of landloss each year. Wang (1987) developed a model specific to navigation channels and their influences on saltwater intrusion using Gosselink et al. (1979) surveys. It demonstrated that, under certain environmental conditions, saltwater penetrates farther inland in deep navigation channels than in shallower channels. This suggests that navigation channels act as “salt pumps.” The Calcasieu Ship Channel is a good example of how this process results in significant habitat transition from freshwater to brackish, and ultimately to salt or open-water systems.

The existing armored navigation channels (such as Port Fourchon) that are used to reach a shore base minimize or eliminate the potential for any shoreline erosion resulting from vessel traffic. In general, widening rates for navigation canals have been reduced as a result of aggressive management and the restoration of canal edges to prevent erosion. Restoration includes the construction of rock breakwaters along portions of some of these canals and the enforcement of “wake zone” speeds (Johnston et al., 2009). The draft of the BOEMRE study entitled *Navigation Canal Bank Erosion in the Western and Central Gulf of Mexico* indicates that shoreline retreat rates along the canals were highly variable within and across unarmored portions of the navigation canals (Thatcher et al., 2011). It was noted that geology and vegetation type influenced the rate of shoreline change. The study noted that the canal widening rate slowed to -0.99 m/yr (-3.25 ft/yr) for the 1996/1998-2005/2006 time period compared with -1.71 m/yr (-5.61 ft/yr) for the earlier 1978/1979-1996/1998 time period. The BOEMRE, in coordination with the Louisiana Dept. of Natural Resources, Coastal Restoration Office, has designed and reviewed a study to better understand salinity as it relates to marshes adjacent to the navigation canal (Snedden, in preparation). The BOEMRE funded the USGS's National Wetlands Resource Center through an Interagency Agreement to perform the 2-year study. Initial work began in January 2010 and is scheduled for completion in December 2011. This will produce useful information on how our navigation canals have affected the adjacent wetlands.

As a result of the DWH event, support vessel traffic originating from Louisiana-based ports can potentially resuspend and transport oil in the sediment from CPA supply bases. However, in the event that resuspension occurs, it is expected to be localized and unlikely to reach the WPA due to the distance of the ports from the CPA facilities.

Disposal of OCS-Related Wastes

Produced sands, oil-based or synthetic-based drilling muds and cuttings; along with fluids from well treatment, workover, and completion activities would be transported to shore for disposal. Sufficient disposal capacity is assumed to be available in support of the proposed action (**Chapter 3.1.2.4**). Discharging OCS-related produced water into inshore waters has been discontinued, so all OCS-produced waters are discharged into offshore Gulf waters in accordance with NPDES permits or transported to shore for injection. Produced waters are not expected to affect coastal wetlands. Because of wetland-protection regulations, no new waste disposal site would be developed in wetlands. Some seepage from waste sites into adjacent wetland areas may occur and result in damage to wetland vegetation. State requirements are expected to be enforced to prevent and correct such occurrences.

Onshore Facilities

Various kinds of onshore facilities service OCS development. These facilities are described in **Chapter 3.1.2**. All projected new facilities that are attributed to the OCS Program and the proposed action would not be in wetland areas. State and Federal permitting agencies discourage the placement of new facilities or expansion of existing facilities in wetlands. Any impacts upon wetlands from existing facilities are expected to be mitigated.

Overview of Existing Mitigation Techniques and Results

Numerous mitigation methods have been recommended and used in the field. Depending on the location, the project, and the surrounding environment, different mitigation techniques may be more appropriate than others. Based on permits, work documents, and interviews, 17 mitigation techniques have been implemented at least once with regards to the OCS. Because no one technique or suite of techniques is routinely required by permitting agencies, each pipeline mitigation process is uniquely designed to minimize damages. This considers the particular setting and equipment to be installed. Of the identified mitigation techniques, there are a number of techniques that are commonly required. Table 4-42 of the Multisale EIS summarizes the recommended mitigating techniques to reduce or avoid adverse impact to wetlands from pipeline construction, canals, dredging, and dredged-material placement. These mitigating methods are the most common applied by the permitting agencies (COE and the State in which the activity has or would occur). These methods may include selective placement of the pipelines in existing rights of way, directional drilling to route under rather than through wetlands, and new restoration and revegetation methods.

Proposed Action Analysis

Construction of up to 2 km (1.2 mi) of onshore pipeline and 0-1 pipeline landfalls are projected in coastal Texas in support of the WPA proposed action. Modern pipelaying techniques and mitigations, including directional drilling and wetlands avoidance, would result in zero to negligible impacts from such a project. For the proposed action, increased use of dredged material to enhance wetland habitats is encouraged as mitigation. On average, 12 percent of traffic using OCS-related navigation channels is related to the OCS Program (Tables 3-36 and 4-4 of the Multisale EIS). Based on the numbers of service-vessel trips projected for the proposed action and the OCS Program (**Table 3-2** of this Supplemental EIS and Table 4-5 of the Multisale EIS), the proposed action is expected to contribute 3.6-5.2 percent of the total OCS Program usage. Therefore, the proposed action would contribute 0.4-0.6 percent to the total commercial traffic using these navigation channels. There are about 700 km (435 mi) of navigation channels that support OCS activity in the WPA. All estimated navigational use is expected to contribute approximately 1.5 m/yr (4.9 ft/yr) to the widening to these channels, or about 1.05 km^2 of landloss per year. Twelve percent, or 13 ha (31 ac), can be attributed to wake erosion from OCS-related vessel traffic (note that several other factors including storms, tides, and subsidence also contribute to canal widening). Of the 13 ha (31 ac) attributed to total OCS-related wake erosion, about 0.47-0.68 ha (1.16-1.68 ac) of landloss per year would be attributed to the WPA proposed action. Therefore, impacts from vessel traffic related to the proposed action should remain minimal. Because of wetland protection regulations, no new waste disposal site would be developed in wetlands. Some seepage from waste sites into adjacent wetland areas may occur and result in damage to wetland vegetation. State requirements are expected to prevent and correct such occurrences. No effects to coastal wetlands from disposal of OCS-related wastes associated with the WPA proposed action are expected.

Summary and Conclusion

The WPA proposed action is projected to contribute to the construction of 0-1 new onshore pipelines. Modern pipelaying techniques and mitigations would be used for such a project. Modern pipelaying techniques use selective placement and directional drilling to avoid wetlands, to reduce the reliance on trenching, and for required restoration; thus, the projected impact to wetlands from pipeline emplacement is expected to be negligible. Because of permit requirements, modern techniques, and mitigation, activities associated with the proposed action are expected to cause negligible to low impacts to wetlands. Secondary impacts to wetlands are caused by existing pipeline and vessel traffic corridors, and these would continue to cause landloss due to erosion. Any potential impacts from the proposed action would be reduced through the continued use of armored channels and modern erosion techniques.

4.1.1.4.3. Impacts of Accidental Events

Background/Introduction

A detailed description of the wetlands resource and accidental impacts from the WPA proposed action are given in Chapters 3.2.1.2 and 4.4.3.2 of the Multisale EIS and Chapter 4.1.3.2.3 of the 2009-2012 Supplemental EIS. There is also a risk analysis of accidental events in **Chapter 3.2.1** of this Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared. The main impact-producing factors that would affect wetlands are oil spills.

Wetlands in the WPA are concentrated landward of the barrier beaches of Texas. The Texas Gulf Coast is comprised of a broad range of saline, brackish, intermediate, and fresh marsh wetlands. These include wet prairies, forested wetlands, barrier islands, mud flats, and riparian wooded areas. Estuarine marshes largely occur as continuous and discontinuous bands around bays, lagoons, and river deltas. Broad expanses of emergent wetland vegetation do not commonly occur south of Baffin Bay (south of Corpus Christi, Texas) because of the arid climate and hypersaline waters. In the vicinity of southern Padre Island, marshes are minimal and unstable as compared with the northern Gulf. Saline and brackish marshes are most widely distributed south of the Galveston Bay area, while intermediate marshes are extensive east of Galveston Bay. The most widespread wetlands along the Texas coast are located in the Strandplain-Chenier Plain System that runs from east Chambers County, Texas, through the Texas/Louisiana border. Hurricane Ike's surge removed the dune systems and significantly lowered the beach elevations along the Galveston's and Bolivar Peninsula's coasts. The erosion and washover associated with the storm surge breeched beach ridges and opened the inland freshwater ponds and their wetlands to the seawater. Due to the degraded shorelines and the reduction in elevation and vegetation on the Texas barrier islands that previously afforded some protection to these coastal fringe marshes, the vulnerability of these wetlands to oil spills has increased.

Proposed Action Analysis

These wetlands are generally more susceptible to contact by inshore spills, which have a low probability of occurrence from OCS-related activities. Inshore vessel collisions may release fuel and lubricant oils, and pipeline ruptures may release crude and condensate oil. Although the impact can occur over all coastal regions, the impact has the highest probability of occurring in Galveston and Matagorda Counties in Texas where the WPA oil is transported onshore for processing and distribution. An estimated 15-34 spills could occur in coastal waters from the WPA proposed action and its support operations (**Table 3-7**). Offshore oil spills are much less likely to contact these wetlands than are inshore spills because these areas are generally protected by barrier islands, peninsulas, sand spits, and currents. The probabilities of an offshore spill ≥1,000 bbl occurring and contacting environmental features are described in Chapter 4.3.1.8 of the Multisale EIS. Six counties in Texas have a chance of spill contact. For these counties, the chance of an OCS offshore spill ≥1,000 bbl occurring and reaching the shoreline ranges from 1 to 15 percent as the result of the proposed action over its 40-year life. Matagorda County has the largest probability (3-5%) of contact in the WPA. Weathering, wave action, and the use of offshore dispersants would reduce the amount of oil that would reach wetland areas, resulting in minimal impacts.

Primary Impacts of Oil Spills

Offshore oil spills associated with the WPA proposed action can result from platform accidents (including blowouts and well explosions), pipeline breaks, or navigation accidents. These spills are much less likely to have a deleterious effect on vegetated coastal wetlands or seagrasses than inshore spills, except with a rare catastrophic spill such as the one associated with the DWH event. The potential effects of these catastrophic spills are discussed in **Appendix B**. Due to the distance of the proposed action to wetlands, coupled with the geology of the Texas coast, the potential for massive oiling of wetland shorelines would be less likely in the WPA than in the CPA. The toxicity of the spilled oil is greatly reduced or eliminated by weathering, wave action, and the use of dispersants (if used to contain the spill in the offshore environment). However, the level of the natural protection once afforded by barrier islands has been reduced, so there is an increased potential for oil to reach inland locations. While there are concerns that offshore spills may contribute to wetland damage, due to the distance of these production facilities offshore, the possibility of toxic oil reaching the coastal wetlands is low.

Coastal oil spills can result from storage, barge, or pipeline accidents. Most of these occur as a result of transfer operations. As discussed in Chapter 4.1.3.4.4.6 of the Multisale EIS, approximately 57 percent of coastal spills occur inland. The most likely locations of coastal spills are at pipeline terminals and other shore bases. The greatest threat to wetland habitat is from an inland spill resulting from a vessel accident or pipeline rupture. Coastal or inland spills are of greatest concern since these spills would be in much closer proximity to the wetland resource. Spills from support vessels would be largely confined in navigation channels and canals. Slicks may quickly spread through the channel by tidal, wind, and vessel currents. Spills that damage wetland vegetation fringing and protecting canal banks would accelerate erosion of those once protected wetlands and spoil banks (Alexander and Webb, 1987).

Both coastal and offshore oil spills can also be caused by large tropical cyclone events such as Hurricanes Katrina, Rita, Gustav, and Ike. These types of storms can damage pipelines by physical movement or disconnection from the storm surge, eroding support structures and leading to pipeline breaks or damaging storage and destruction of refining facilities. Remnant winds and surges can potentially spread oil from platforms or distribution site on the OCS to the waters of the WPA depending on proximity.

While a resulting slick may cause minor impacts to wetland habitat, the equipment and personnel used to clean up a slick over the impacted area may generate the greatest impacts to the area. Associated foot traffic may work oil farther into the sediment than would otherwise occur. Close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to minimize or avoid those impacts. The fate and behavior of oil spills, the availability and adequacy of oil-spill containment and cleanup technologies, different oil-spill clean-up strategies, the impacts of oil-spill cleanup methods, the effects of weathering on oil, the toxicological effects of fresh and weathered oil, the air pollution associated with spilled oil, and the short- and long-term impacts of oil on wetlands are additional concerns.

Numerous investigators have studied the immediate impacts of oil spills on Gulf wetland habitats and other wetland habitats elsewhere similar to those affected by OCS activities. Often, seemingly contradictory conclusions are generated from these impact assessments. These contradictions can be explained by differences in many parameters, including oil concentrations and chemical composition, vegetation type and density, season or weather, preexisting stress level on the vegetation, soil types, and water levels. Data suggest vegetation that is lightly oiled would experience plant die-back, followed by recovery without replanting, so most impacts to vegetation are considered to be short term and reversible (Lytle, 1975; DeLaune et al., 1979; Webb et al., 1985; Alexander and Webb, 1987; Fischel et al., 1989).

Shoreline types have been rated via Environmental Sensitivity Indices (ESI's) and, according to their expected retention of oil and some biological effects, they exhibit oil persistence (Hayes et al., 1980; Irvine, 2000). Oil has been found or estimated to persist for at least 17-20 years in low-energy environments like salt marshes (Teal et al., 1992; Baker et al., 1993; Burns et al., 1993; Irvine, 2000). In some instances, where there has been further damage due to cleanup activities, recovery has been estimated to take from 8 to 100 years (Baca et al., 1987). Effects on marsh vegetation can be severe (Baca et al., 1987; Baker et al., 1993). The long-term recovery times occurred in nutrient-limited, colder environments, where biodegradation is limited; however, those conditions are unlike the nutrient-rich marshes of the Gulf Coast. An effect from the depletion of marsh vegetation is increased erosion, which is of special concern to coastal Louisiana and parts of coastal Texas. Cleanup activities in marshes that can last years to decades following a spill may accelerate erosion rates and retard recovery rates.

Because OCS-related pipelines traverse wetland areas, pipeline accidents could result in high concentrations of oil directly contacting localized areas of wetland habitats (Fischel et al., 1989). The fluid nature of the oil, water levels, weather, and the density of the vegetation would limit the area of interior wetlands contacted by any given spill. Other studies have noted that oil is more persistent in anoxic sediments and, as a result of this longer residence time, have the potential to do damage to both marsh vegetation and associated benthic species. The sediment type, the anoxic condition of the soils, and whether the area is in a low or high energy environment all play a part in the persistence of oil in marsh sediment (Teal and Howarth, 1984). Based on data from Mendelssohn et al. (1990), recovered vegetation is expected to be the ecologically functional equivalent of unaffected vegetation. This study tested the reduction in plant density as the principle impact from spills. Mendelssohn and his associates demonstrated that oil could persist in the soil for greater than 5 years if a pipeline spill occurs within the interior of a wetland where wave-induced or tidal flushing is not regular or vigorous (Mendelssohn et al., 1990). Since most of the wetlands along the Texas coast are either in moderate to high energy environments, sediment transport and tidal stirring should reduce the chances for oil persisting in the event that these areas are oiled.

Wetlands in Texas occur on a more stable substrate and receive more inorganic sediment per unit of wetland area than wetlands in Louisiana. Texas wetlands have not experienced the extensive alterations caused by rapid submergence rates and extensive canal dredging that affect Louisiana wetlands. The examinations of Webb and colleagues (Webb et al., 1981 and 1985; Alexander and Webb, 1983) are used to evaluate impacts of spills in these settings. The critical concentration of oil is that concentration above which impacts to wetlands would be long term, because recovery would take longer than two growing seasons, and which causes plant mortality and permanent wetland loss. Critical concentrations of different oils are unknown and expected to vary broadly for wetland types and plant species. Louisiana wetlands are assumed to be more sensitive to oil contact than elsewhere in the Gulf because of high cumulative stress. But for wetlands along more stable coasts (Texas), the critical oil concentration is assumed to be 1.0 L/m^2 (Alexander and Webb, 1983). Concentrations below the expected 1.0 L/m^2 would result in short-term, above-ground dieback for one growing season. Concentrations above this would result in longer-term impacts to wetland vegetation, including plant mortality extensive enough to require recolonization. Using these studies, the OSRA model predicted for every 50 bbl of oil spilled and contacting wetlands, approximately 2.7 ha (6.7 ac) of wetland vegetation would experience dieback (Chapter 4.4.3.2 of the Multisale EIS). Also, 30 percent of these damaged wetlands are assumed to recover within 4 years, and 85 percent within 10 years. About 15 percent of the contacted wetlands are expected to convert to open-water habitat permanently.

Secondary Impacts of Oil Spills

The short-term effects of oil on wetland plants range from reduction in transpiration and carbon fixation to plant mortality. Depending on the type and quantity of oil in the sediment, mineralization of nutrients can be blocked so there is less nutrient uptake from the soils. The potential impact of the oiling on the wetland habitats is dependent on several factors, which include season, wetland (fresh, salt, or brackish), sediment type, oil type, and quantity and degree of oiling. In general, most wetland plants are more susceptible to impacts from oiling during the growing season. Heavy oil causes mortality by coating gas exchange surfaces on the plants and by sealing sediment, which limits nutrient exchange to below ground tissue. Light-weight oils have been found to be more toxic to the marsh plants and associated organisms because the oil alters membrane permeability and disrupts metabolism (Pezeshki et al., 2000). Due to the difference in oil tolerances of various wetland plants, changes in species composition may be evident as a secondary impact of the spill (Pezeshki et al., 2000). Studies indicated that some dominant freshwater marsh species (*Sagittaria lancifolia*) are tolerant to oil fouling and that some may recover without being cleaned (Lin and Mendelssohn, 1996). Even though some species recover from fouling without being cleaned and others benefit from cleaning (Pezeshki et al., 2000), further studies by Mendelssohn et al. (1990 and 1993) noted that the plant composition in an oiled marsh can be changed post-spill as a result of plant sensitivity to oil. So, there can be a trade off from the disturbance within these wetlands resulting from workers gaining access to the plants by foot or boat and the potential benefits of cleaning. The compaction of the soil in combination with the oiling may further stress the plants and result in greater mortality (Pezeshki et al., 1995).

As noted earlier, cleanup of these sensitive wetland habitats can be more disruptive and sometimes damaging than the oiling incident itself. Following the DWH event, USEPA and the USCG's National Incident Command held a technology workshop and established an Interagency Alternative Technology Assessment Program (IATAP). This IATAP included numerous Federal agencies and local marsh ecologist with expertise concerning oil-spill cleanup to determine the least damaging approach to oil cleanup in these fragile coastal environments (U.S. Dept. of Homeland Security, CG, 2010c). The IATAP group reviewed various methods of response that could be used in areas that, based on hydrologic modeling, would receive oil. Current methods to clean up oil spills include mechanical and chemical removal, in situ burning, and bioremediation. The IATAP work group reviewed these and other mitigating measures specifically for areas where the vegetation had already been oiled. The IATAP recommended to keep the oil offshore and out of the marshes as long as possible, to not use actions that would further drive oil into the sediment (e.g., vessel and foot traffic), to not burn oil-contaminated vegetation if the water depth is insufficient or if there is the potential for re-oiling (this may result in root damage), to not apply dispersants in the marsh, to not use high-pressure washing that could drive oil deeper in sediments, to not hand clean vegetation (utilize low-pressure flushing if possible), and to monitor the utilization of sorbent booms. Bioremediation recommendations from the group were to minimize or eliminate vessel and foot traffic; mechanical removal methods should not disturb the substrate. Consideration was given to using nutrients and bacteria or fungi to enhance biodegradation. However, since the Gulf Coast is not nutrient limited, it was determined not to be useful. Two crucial points made by IATAP workgroup were (1) the use of particular cleanup methods is situation-dependent and (2) in the case of marshes it is best to do nothing and let nature take its course. The clean up of oil spills in coastal marshes remains a problematic issue because wetlands can be extremely sensitive to the disturbances associated with cleanup activities. Once a marsh is impacted by an oil spill, a decision must be made concerning the best method of cleanup and restoration. Often the best course of action is to let the impacted area(s) recover naturally in order to avoid secondary impacts associated with the cleanup process, such as trampling vegetation, accelerating erosion, and burying oil (McCauley and Harrel, 1981; Long and Vandermeulen, 1983: Getter et al., 1984; Baker et al., 1993; and Mendelssohn et al., 1993).

Summary and Conclusion

Offshore oil spills resulting from the WPA proposed action are not expected to extensively damage any wetlands along the Gulf Coast. This is because of the distance of the spill to the coast and because wetlands are generally protected by barrier islands, peninsulas, sand spits, and currents. Although the probability of occurrence is low, the greatest threat of an oil spill to wetland habitat is from an inland spill as a result of a vessel accident or pipeline rupture. Wetlands in the northern Gulf of Mexico are in moderate- to high-energy environments; therefore, sediment transport and tidal stirring should reduce the chances for oil persisting in the event that these areas are oiled. While a resulting slick may cause minor impacts to wetland habitat, the equipment and personnel used to clean up the spill can generate the greatest impacts to the area. Associated foot traffic can work oil farther into the sediment than would otherwise occur. Close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize those impacts. Overall, impacts to wetland habitats from an oil spill associated with activities related to the WPA proposed action would be expected to be low and temporary because of the nature of the system, regulations, and specific cleanup techniques.

4.1.1.4.4. Cumulative Impacts

A detailed description of cumulative impacts upon wetlands can be found in Chapter 4.5.3.2 of the Multisale EIS and in Chapter 4.1.3.2.4 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Background/Introduction

This cumulative analysis considers the effects of impact-producing factors related to the proposed action, prior and future OCS activities, State oil and gas activities, other governmental and private projects and activities, and pertinent natural processes and events that may adversely affect wetlands during the life of the proposed action. Impacts from residential, commercial, agricultural, and silvicultural (forest expansion) developments are expected to continue in coastal regions around the Gulf. Existing regulations and development permitting procedures indicate that development-related wetland loss may be slowed and that 1-2 new onshore pipeline facilities, other than pipelines (6-8 landfalls), would be constructed in wetlands for the estimated life time (40 years) of the proposed action (Table 4-9 of the Multisale EIS). Impacts from State onshore oil and gas activities are expected to occur as a result of dredging for new canals, maintenance, and usage of existing rig access canals and drill slips, and preparation of new well sites. Locally, subsidence may be due to the extraction of large volumes of oil and gas from subsurface reservoirs, but subsidence associated with this factor seems to have slowed greatly over the last three decades as the reservoirs are depleted. Recent information indicates that subsurface transfer faults are adjusting to re-fill areas where salt has been evacuated and may be adding to the base subsidence along Gulf Coast (Stephens, 2010b). Indirect impacts from dredging new canals for State onshore oil and gas development and from the maintenance of the existing canal network is expected to continue (Chapter 4.1.3.3.3 of the Multisale EIS). Maintenance dredging of the OCS-related navigation channels accounts for 10 percent of the dredged material produced.

Insignificant adverse impacts upon wetlands from maintenance dredging are expected because the large majority of the material would be disposed upon existing disposal areas. Alternative dredged material disposal methods can be used to enhance and create coastal wetlands. Depending upon the regions and the soils through which they were dredged, secondary adverse impacts of canals may be more locally significant than direct impacts. Additional wetland losses may be generated by the secondary impacts of saltwater intrusion, flank subsidence, freshwater-reservoir reduction, and deeper tidal penetration. A variety of mitigation efforts have been initiated to protect against direct and indirect wetland loss. The nonmaintenance of mitigation structures that reduce canal construction impacts can have substantial impacts upon wetlands. These localized impacts are expected to continue. Various estimates of the total, relative direct and indirect impacts of pipeline and navigation canals on wetland loss vary enormously; they range from estimates of 9 percent (Britsch and Dunbar, 1993) to 33 percent (Penland et al., 2001a and 2001b) to estimates of greater than 50 percent (Turner et al., 1982; Scaife et al., 1983; Bass and Turner, 1997). A panel review of scientific evidence suggests that wetland losses directly attributable to all human activities account for less than 12 percent of the total wetland loss experienced since 1930 and approximately 29 percent of the total losses between 1955 and 1978 (Boesch et al., 1994). Of these direct losses, 33 percent are attributed to canal and spoil bank creation (10 percent of overall wetland loss). In Louisiana, deepening the Fourchon Channel to accommodate larger OCS-related service vessels has occurred within a saline marsh environment and will afford the opportunity to create wetlands with the dredged materials. Deepening the Corpus Christi and Houston Ship Channels, which is non-OCS-related activity, should also afford the opportunity to create wetlands with dredged material.

The main factors that continually effect wetlands from OCS activities are dredging, navigation channels and canals, pipelines, oil spill, and development of wetlands. The following is a summary of these effects on the wetlands and how the proposed action would not add significant negative effects to wetlands.

Dredging of Channels

Maintenance dredging of navigation channels and canals is expected to occur with minimal impacts, because the WPA proposed action is expected to use existing navigation channels and contribute minimally to the need for this dredging. Alternative dredged material disposal methods can be used to enhance and create coastal wetlands. Impacts from State onshore oil and gas activities are expected to occur as a result of dredging for new canals, maintenance, and usage of existing rig access canals and drill slips, and preparation of new well sites. Insignificant adverse impacts upon wetlands from maintenance dredging are expected because the large majority of the material would be disposed upon existing disposal areas. Through its beneficial use program, COE requires alternative dredged material disposal methods to be used to enhance and create coastal wetlands. The COE also requires alternate bank disposal of dredged material, which preserves the tidal hydrology and sheet flow within the marshes therefore minimizing marsh loss. Depending upon the dredging regions and soils, secondary adverse impacts of canals may be more locally significant than direct impacts. In a recent study that quantified erosion rates to determine whether differences in those rates were related to embankment substrate, vegetation type, geologic region, or soil type, it was found that substrate, vegetation cover, and rock armor were positive factors in reducing erosion (Thatcher et al., 2011). The WPA proposed action is expected to contribute minimally to the need for maintenance dredging.

The OCS activities are expected to result in some level of dredging activity associated with the expansion of offshore platforms or onshore transfer or production facilities if needed. The primary indirect impacts from dredging would be wetland loss as a result of saltwater intrusion or vessel traffic erosion. However, the primary support, transfer, and production facilities used for the WPA proposed action are located along armored canals and waterways, thus minimizing marsh loss.

Navigation Channels and Canals

The effects of pipelines, canal dredging, and navigation activities on wetlands are described in Chapter 4.2.1.1.3.2 of the Multisale EIS. Subsidence of wetlands is discussed in more detail in Chapter 4.1.3.3.1 of the Multisale EIS.

Landloss would continue from subsidence induced by saltwater intrusion especially in the areas behind the beach heads degraded or channelized by the cumulative effects of Hurricanes Katrina, Rita, Gustav, and Ike. Hurricane Ike, specifically, damaged the large beach heads around High Island, McFaddin National Wildlife Refuge, and the Bolivar Peninsula (all in Texas). This damage provided a pathway for saltwater intrusion into the marshes behind those beach heads. Landloss would continue from vessel traffic; however, based on the minimal increase in traffic caused by the proposed action, the loss would be minimal. The proposed action would not require any channel maintenance, and therefore no additional wetland loss would result from dredged material disposal. If dredged material disposal is required, it may be beneficially used for marsh creation. Vessel trips associated with the WPA proposed action would be less than those previously estimated in Table 4-5 of the Multisale EIS. There are now an estimated 76,000-141,000 vessel trips (**Table 3-2**). Disposal of OCS wastes and drilling by-products would be delivered to existing facilities; no additional wetland acres would be utilized.

As noted in the referenced chapters above, the previous OCS activities associated with the WPA are expected to require some level of dredging, channel deepening, and maintenance of access canals. Onshore activity that would further accelerate wetland loss includes additional construction of access channels, and drill slips and onshore action needed for construction of new well sites and expansion or construction of onshore and offshore facilities (production platforms or receiving and transfer facilities). Most of these facilities would be located in Louisiana and would minimally impact wetlands in the WPA. Management activities, including erosion protection and restoration along the edges of these canals, can significantly reduce canal-widening impacts on wetland loss (Johnston et al., 2009; Thatcher et al., 2011). These and similar studies are discussed in detail in **Chapter 4.1.1.4.2**. Impacts resulting from activities related to navigation canals can be mitigated with bank stabilization, and where possible, the beneficial use of dredged material (produced during maintenance dredging activities) to create wetland or upland habitats. The service vessels associated with the WPA proposed action would generate an estimated 76,000-141,000 trips annually, which is 1-2 percent of the total OCS traffic (12% of all vessel traffic) generated in the Gulf of Mexico. Based on these estimates, the vessel-induced erosion associated with the proposed action is minimal.

Pipelines

Modern pipeline installation methods and impacts are described in Chapters 4.1.1.8.1 and 4.1.2.1.7 of the Multisale EIS. While impacts are greatly reduced by mitigation techniques, remaining impacts may include expansion of tidal influence, saltwater intrusion, hydrodynamic alterations, erosion, sediment transport, and habitat conversion (Cox et al., 1997; Morton, 2003; Ko and Day, 2004b). The majority (over 80%) of OCS-related direct land loss is estimated to be from OCS pipelines (Turner and Cahoon, 1988). Since the beginning of OCS activities in the Gulf of Mexico, approximately 15,400 km (9,563 mi) of OCS pipelines have been constructed in Louisiana. These are seaward of the inland CZM boundary to the 3-mi State/Federal boundary offshore. Of those pipelines, about 8,000 km (4,971 mi) cross wetland and upland habitat mostly in Louisiana. The remaining 7,400 km (4,595 mi) cross waterbodies (Johnston et al., 2009). The total length of non-OCS pipelines through wetlands is believed to be approximately twice that of the Gulf OCS Program, or about 15,285 km (9,492 mi). There is a total of approximately 23,285 km (14,460 mi) of pipelines through Louisiana coastal wetlands. The majority of OCS pipelines entering State waters ties into existing pipeline systems and does not result in new landfalls. Pipeline maintenance activities that disturb wetlands are very infrequent and are mitigated to the maximum extent practicable.

The widening of OCS pipeline canals does not appear to be an important factor contributing to OCS-related direct landloss. This is because few pipelines are open to navigation, and the impact width does not appear to be significantly different from that for open pipelines closed to navigation. Based on the projected coastal Louisiana wetlands loss of 132,607 ha (327,679 ac) for the years 2000-2040 (Barras et al., 2003), landloss resulting from new OCS pipeline construction represents <1 percent of the total expected wetlands loss for that time period (Chapter 4.5.3.2 of the Multisale EIS). This estimate does not take into account the present regulatory programs and modern installation techniques. Today, pipeline canals are much narrower than in the past because of advances in technology and improved methods of installation. These advances are due to a greater awareness among regulatory agencies and industry (Johnston et al., 2009). The magnitude of impacts from OCS-related pipelines is inversely proportional to the quantity and quality of mitigation techniques applied. Pipelines with extensive mitigation measures appeared to have minimal impacts, while pipelines without such measures contributed to significant habit changes. Impacts can be minimized or altogether avoided through proper construction methods, mitigation, and maintenance. The BOEMRE is not a permitting agency for onshore pipelines. The permitting agencies are COE and the State in which the activity has or would occur. Therefore, it would be the responsibility of COE and the States to ensure that wetland impacts resulting from pipeline construction are properly mitigated and monitored. Throughout the 40-year life of the proposed action, a majority of the already old pipeline distribution and production systems would continue to age. This could result in an increasingly large inventory of pipelines and support structures that would need to be replaced or repaired. The replacement and repair of the inland pipeline system may temporarily impact wetlands in the pipeline corridors, but if proper mitigation is implemented and maintained, impacts should be minimal and temporary. In the absence of the replacement of these aging pipelines, the potential risk for spills and leaks would increase in nearshore, inland, and offshore waters.

Oil Spills

The potential for oil spills would continue with coastal/inland spills. This creates the greatest concern for coastal wetlands due to the proximity of the spills to these vegetated areas. Aging infrastructure including refineries, onshore production facilities, platforms, and pipelines would continue to be an increasingly potential source of both inland and offshore spills. Over 3,000 production platforms in the Gulf are over 20 years old and were constructed prior to the modern structural requirements that increase endurance to hurricane force winds (Casselman, 2010). Improperly capped or marked abandoned wells also add to the possibility for future oil spills as a result of leaks or vessel collisions. The surge from

Hurricane Ike caused damage to many oil production facilities in the Goat Island and High Island area of Texas, and resulted in the release of oil that affected approximately 1,011-1,214 ha (2,500-3,000 ac) of wetlands (Gable, 2008). An estimated additional 1,497 ha (3,700 ac) of Federal and State refuges were also affected with varying degrees of oiling resulting from the storm-damaged facilities. Future spills from these types of facilities would be less likely because these older facilities are either structurally updated to withstand larger storms or replaced.

Oil from offshore spills is less likely to reach the coastal wetlands in a fully toxic condition due to weathering, dispersant treatment, and the blockage of spills by barrier islands. However, any reduced elevation and erosion of these barriers by Hurricanes Katrina, Rita, and Ike decrease the level of protection afforded the mainland (USDOC, NMFS, 2007a; Doran et al., 2009). Hurricane Ike severely damaged the Bolivar Peninsula, especially the protective beaches and dunes around High Island, Crystal Beach, and the National and State wildlife refuges (Doran et al., 2009). Dunes were lowered and inlets were cut into the beach face, which allowed saltwater intrusion into the once-protected wetlands behind these beaches. In some areas, freshwater ponds emptied through the intertidal channels cut by the storm and robbed wetlands of a freshwater supply. This reduced protection from the beach heads and dunes can also allow oil to penetrate further into the mainland and fringe marshes. Flood tides may now bring some oil through tidal inlets into areas landward of barrier beaches. The turbulence of tidal water passing through most tidal passes would break up the slick, thereby accelerating dispersion and weathering. For the majority of these situations, light oiling of vegetated wetlands may occur. This oil contributes less than 0.1 L/m^2 on wetland surfaces. Any adverse impacts that may occur to wetland plants are expected to be very short lived, probably less than 1 year. Coastal OCS spills could occur as a result of pipeline accidents and barge or shuttle tanker accidents during transit or offloading. The frequency, size, distribution, and impact of OCS coastal spills are provided in Chapter 4.3.1.7 of the Multisale EIS. Non-OCS spills can occur in coastal regions as a result of import tankers, coastal oil production activities, and petroleum product transfer accidents. Their distribution is believed to be similar to that described in Chapter 4.3.1 of the Multisale EIS. Numerous wetland areas have declined or been destroyed as a result of oil spills caused by pipeline breaks or tanker accidents.

Oil stresses the wetland communities, making them more susceptible to saltwater intrusion, drought, disease, and other stressors (Ko and Day, 2004b). The past discharge of saltwater and drilling fluids associated with oil and gas development has been responsible for the decline or death of some local marshes (Morton, 2003). Discharging OCS-related produced water into inshore waters has been discontinued, and all OCS-produced waters transported to shore are either injected or disposed of in Gulf waters and would not affect coastal wetlands (Chapter 4.1.1.4.2 of the Multisale EIS).

The numbers and sizes of coastal spills are presented in Table 4-13 of the Multisale EIS. About 95 percent of these spills are projected to be from non-OCS-related activity. Of coastal spills <1,000 bbl, the assumed size is 5 bbl; therefore, the great majority of coastal spills would affect a very small area and dissipate rapidly. The small coastal spills that do occur from OCS-related activity would originate near terminal locations in the coastal zones of Texas, Louisiana, Mississippi, and Alabama but primarily within the Houston/Galveston area of Texas and the deltaic area of Louisiana. An average of three large (≥10,000 bbl) offshore spills is projected to occur annually in the WPA from all OCS sources over a 40-year scenario (Table 4-15 of the Multisale EIS). One offshore spill ≥1,000 bbl is estimated to occur every year from the Gulfwide OCS Program (Table 4-13 of the Multisale EIS). A total of 1,000-1,200 smaller (<1,000 bbl) offshore spills are projected annually from the Gulfwide OCS Program (Table 4-13 of the Multisale EIS). Chapter 4.3.1 in the Multisale EIS describes projections of future spill events in more detail.

Development of Wetlands

The development of wetlands for agricultural, residential, and commercial uses would continue but with more regulatory and planning constraints. Wetland damage would be minimized through the implementation of CZM guidelines, COE regulatory guidelines for wetland development, and various State and Federal coastal development programs. Examples of these programs are the Coastal Impact Assistance Program (CIAP), Louisiana's Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA), and Louisiana Coastal Protection and Restoration Project (LACPR).

The past discharge of saltwater and drilling fluids associated with oil and gas development has been responsible for the decline or death of some marshes (Morton, 2003). Discharging OCS-related produced water into inshore waters has been discontinued and all OCS-produced waters transported to shore would either be injected or disposed of in Gulf waters and would not affect coastal wetlands (Chapter 4.1.1.4.2 of Multisale EIS). Dredged material would be deposited either in existing approved discharge sites or would be used beneficially for wetland restoration or creation. The major ports supporting the offshore facilities are still primarily located in Louisiana waters even though production may be transported to Texas. In Port Fourchon, Louisiana, some of the existing areas being filled with dredged material may be used, if needed, for the expansion of oil production or support facilities. Currently, the CWPPRA program is actively engaged in restoring the protective headlands in the Fourchon area. In Texas, the J.D. Murphree State Wildlife Management Area complex is undergoing restoration in an effort to reestablish beach face and protective dunes that were removed by Hurricane Ike.

Cumulative loss of wetlands has occurred as a result of both natural and anthropogenic events. Natural subsidence has caused wetland loss through compaction of Holocene strata (the rocks and deposits from 10,000 years ago to present). Human factors such as onshore oil and gas extraction, groundwater extraction, drainage of wetland soils, and burdens placed by buildings roads and levees have also caused wetland loss. Areas of local subsidence have also been correlated to the past extraction of large volumes of underground resources including oil, gas, water, sulfur, and salt (Morton, 2003; Morton et al., 2002 and 2005). There is increasing new evidence of the importance of the effect of sea-level rise (or marsh subsidence) as it relates to the loss of marsh or changes in marshes, marsh types, and plant diversity (Spalding and Hester, 2007). This study shows that the very structure of coastal wetlands would likely be altered by sea-level rise because community shifts would be governed by the responses of individual species to new environmental conditions. Flood control and channel training along the Mississippi River would continue to deprive the delta of the needed sediment required for the creation or maintenance of the existing wetlands. Another recent development that is presently being proposed along the Mississippi coast, but planned for the Louisiana and Texas coasts, is the preparation of salt domes for the storage of strategic oil reserves. The current plan would result in discharging highly concentrated salt solutions into the nearshore Gulf and bays. The potential for large modifications (increases) in coastal salinities could result in devastating or severely compromising the coastal marshes (Mississippi Press, 2007).

As a result of the increase in frequency and intensity of tropical storms and hurricanes in the last 6 years, both natural and developed coastal communities have been severely damaged. In order to minimize or prevent future damages resulting from these storms, changes have been made in regulations regarding coastal development and government-funded projects for coastal restoration. Future coastal development is expected to be more environmentally compatible with the natural protective features of the coast (wetlands, dunes, and barrier islands). This is because Federal, State, and local regulatory and natural resource agencies cooperatively plan coastal development.

Summary and Conclusion

Wetlands are most vulnerable to inshore or nearshore oil spills, but these are localized events. Spill sources include vessel collisions, pipeline breaks, and shore-based transfer, refining, and production facilities. The wetlands associated with the WPA proposed action have a minimal probability for oil-spill contact. This reduced risk is due to the distance of the offshore facility to wetland sites, beach and barrier island topography (although reduced locally post-Hurricanes Katrina, Rita, Gustav, and Ike), and product transportation through existing pipelines or pipeline corridors. Wetlands can also be at risk for offshore spills, but the risks are minimized by distance, time, sea conditions, and weather. If they do reach shore, only light localized impacts to inland wetlands would occur. If any spills occur, they would likely be small and at inland service bases or other support facilities generally located away from wetlands; therefore, the spills would not be expected to affect wetlands.

As a result of Hurricane Ike, some of the State and national wildlife refuges along the eastern Texas coast would continue to experience some landloss through storm-induced saltwater intrusion. However, coastal restoration projects are either ongoing or planned to restore the natural protection to the marshes in these refuges and management areas. Landloss would continue from vessel traffic; however, because of the small increase in traffic caused by the proposed action, this loss would be minimal. The WPA proposed action would not require any channel maintenance; therefore, no additional wetland loss would result from dredged material disposal. If dredged material disposal is required, it may be beneficially used for marsh creation. Disposal of OCS wastes and drilling by-products would be delivered to existing facilities. Because of existing capacity, no additional expansion into wetland is expected.

Development pressures in the coastal regions of Texas have been primarily the result of tourism and residential beach side development in the Galveston and Bolivar Peninsula areas. In Galveston, recreation and tourist developments have been particularly destructive. These trends are expected to continue, but since Hurricane Ike, redevelopment is being coordinated with the natural resource agencies in an effort to assure compatibility of the new construction with the coastal environment to minimize impacts.

If pipelines are needed, the modern construction techniques and mitigation measures would result in zero to negligible impacts on wetland habitats because modern techniques avoid wetlands through selective emplacement in existing corridors, directional drilling to avoid additional trenching, and required restoration and revegetation techniques. The WPA proposed action represents a small (>5%) of the OCS impacts that would occur over the 40-year analysis period. Impacts associated with proposed WPA Lease Sale 218 are a minimal part of the overall OCS impacts. The cumulative effects of human and natural activities in the coastal area have severely degraded the deltaic processes and have shifted the coastal area from a condition of net land building to one of net landloss. Deltaic Louisiana is expected to continue to experience the greatest loss of wetland habitat. Wetland loss is also expected to continue in coastal Texas, but at slower rates. The incremental contribution of the proposed action to the cumulative impacts on coastal wetlands is expected to be small.

The incremental contribution of the WPA proposed action to the cumulative impacts to coastal wetlands is expected to be small. The primary impacting factors attributable to the proposed action are pipeline landfalls, canal widening, and maintenance dredging of navigation canals. However, activities associated with proposed WPA Lease Sale 218 require no additional navigation canals; at most, it would require one new pipeline landfall and no increase in channel maintenance of existing channels. The use of existing onshore processing and transfer facilities and existing pipelines in established transportation corridors eliminates the need for dredging or construction activities that would cause result in additional wetland losses as a result of the proposed action. The WPA proposed action would use existing disposal sites approved for receiving OCS related wastes; therefore, no additional wetlands would be needed for this purpose.

4.1.1.5. Seagrass Communities

The BOEMRE has reexamined the analysis for seagrass communities presented in the Multisale EIS and the 2009-2012 Supplemental EIS (addition of 181 South Area) based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusion for seagrass communities presented in the Multisale EIS and the 2009-2012 Supplemental EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS. A summary of those analyses and their reexamination due to new information is presented in the following sections. A brief summary of potential impacts follows. Turbidity impacts from pipeline installation and maintenance dredging associated with the WPA proposed action would be temporary and localized. The increment of impacts from service-vessel transit associated with the WPA proposed action would be minimal. Should an oil spill occur near a seagrass community, impacts from the spill and cleanup would be considered short term in duration and minor in scope. Close monitoring and restrictions on the use of bottom-disturbing equipment to clean up the spill would be needed to avoid or minimize those impacts. Of the cumulative activities, dredging generates the greatest overall risk to submerged vegetation, while hurricanes cause direct damage to seagrass beds, which may fail to recover in the presence of cumulative stresses. The WPA proposed action would cause a minor incremental contribution to cumulative impacts due to dredging from maintenance of channels

4.1.1.5.1. Description of the Affected Environment

A detailed description of seagrass communities in the WPA (Texas and because of its close proximity to the area, Louisiana is also discussed) can be found in Chapter 4.2.1.1.3.3 of the Multisale EIS. Additional information regarding the additional 181 South Area and any new information found since the publication of the Multisale EIS is presented in Chapter 4.1.3.3 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

A search was conducted for new information published on submerged vegetation, and various Internet sources were examined to determine any recent information regarding seagrasses. Sources investigated include BOEMRE, USDOC/NOAA, the USGS National Wetlands Research Center, the USGS Gulf of Mexico Integrated Science Data Information Management System, Seagrass Watch, Gulf of Mexico Alliance, State environmental agencies, USEPA, and coastal universities. Other websites from scientific publication databases were checked for new information using general Internet searches based on major themes. New information is discussed below.

Submerged vegetation distribution and composition depend on an interrelationship among a number of environmental factors that include water temperature, depth, turbidity, salinity, turbulence, and substrate suitability (Kemp, 1989; Onuf, 1996; Short et al., 2001). Marine seagrass beds generally occur in shallow, relatively clear, protected waters with sand bottoms (Short et al., 2001). Freshwater submerged aquatic vegetation (SAV) species occur in the low-salinity waters of coastal estuaries (Castellanos and Rozas, 2001). True seagrasses that occur in the Gulf of Mexico are *Halodule beaudettei* (formerly *Halodule wrightii;* shoal grass), *Halophila decipiens* (paddle grass), *Halophila engelmannii* (star grass), *Syringodium filiforme* (manatee grass), and *Thalassia testudinum* (turtle grass) (Short et al., 2001; Handley et al., 2007). Although it is not considered a true seagrass because it has hydroanemophilous pollination (pollen grains float) and can tolerate freshwater, *Ruppia maritima* (widgeon grass) is common in the brackish waters of the Gulf of Mexico (Zieman, 1982; Berns, 2003; Cho and May, 2008). Freshwater genera that are dominant in the northern Gulf of Mexico are *Ceratophyllum*, *Najas*, *Potamogeton*, and *Vallisneria* (Castellanos and Rozas, 2001; Cho and May, 2008). Submerged vegetation increases protection from predation and food resources for associated nekton (Rozas and Odum, 1988; Maiaro, 2007). Seagrasses and freshwater SAV's provide important nursery and permanent habitat for sunfish, killifish, immature shrimp, crabs, drum, trout, flounder, and several other nekton species, and they provide a food source for species of wintering waterfowl and megaherbivores (Rozas and Odum, 1988; Rooker et al., 1998; Castellanos and Rozas, 2001; Heck et al., 2003; Orth et al., 2006). They also act in carbon sequestration, nutrient cycling, and sediment stabilization (Heck et al., 2003; Duarte et al., 2005; Orth et al., 2006). They provide substrate for epiphytes to grow, which can be a hindrance (shading) if too thick to the seagrass, but those epiphytes serve as another food source to different species (Howard and Short, 1986; Bologna and Heck, 1999).

According to the most recent and comprehensive data available, approximately 500,000 ha (1.25 million ac) of seagrass beds are estimated to exist in exposed, shallow coastal/nearshore waters and embayments of the Gulf of Mexico; over 80 percent of these beds are in Florida Bay and Florida coastal waters (calculated from Handley et al., 2007). In the northern Gulf of Mexico from south Texas to Mobile Bay, seagrasses occur in relatively small beds behind barrier islands in bays, lagoons, and coastal waters (**Figure 4-3**); while SAV's occur in the upper freshwater regions of estuaries and rivers (Onuf, 1996; Castellanos and Rozas, 2001; Handley et al., 2007). Increased nutrients and sediments from either natural or anthropogenic events such as tropical cyclones and watershed runoff are common and significant causes of seagrass decline (Carlson and Madley, 2007). Recent increases in natural and anthropogenic stresses have led to decreases in these communities worldwide (Orth et al., 2006). For example, in Texas, construction and maintenance of the Gulf Intracoastal Waterway and the "Texas brown tide" event in the 1990's contributed to the decline in seagrass beds in the Laguna Madre (Pulich and Onuf, 2007). The USGS's *Seagrass Status and Trends in the Northern Gulf of Mexico: 1940-2002* demonstrated a decrease of seagrass coverage from approximately 1.02 million ha (2.52 million ac) estimated in 1992 to approximately 500,000 ha (1.25 million ac) calculated in the 2002 report (Handley et al., 2007). While declines have been documented for different species in different areas, it is difficult to estimate rates of decrease because of the fluctuation of biomass among the different species, seasonally and yearly.

Seagrasses in Texas are mostly found in widely scattered beds in shallow, high-salinity coastal lagoons and bays that are protected by barrier islands. Although permanent meadows of perennial species occur in nearly all bay systems along the Texas Gulf Coast, most of the State's seagrass cover is found in the Laguna Madre, a large body of shallow water separating Padre Island from the south Texas mainland (Onuf, 1996; Texas Parks and Wildlife Department, 1999; Pulich and Onuf, 2007). Throughout the rest of Texas, lower-salinity SAV beds are found inland and discontinuously in coastal lakes, rivers, and the most inland portions of some coastal bays (Texas Parks and Wildlife Department, 1999). In the past 6 years, nine tropical cyclone events (Hurricanes Emily and Rita in 2005, Tropical Storm Erin and Hurricane Humberto in 2007, Tropical Storms Dolly and Eduardo and Hurricane Ike in 2008, and Hurricane Alex and Tropical Storm Hermine in 2010) have passed over/made landfall near Texas (USDOC, NOAA, 2010d). Many of the storms were near Galveston or the Texas-Louisiana border that has higher abundances of SAV, but two of the most recent storms (Alex and Hermine) were south of Padre Island where there are high abundances of seagrass (USDOC, NOAA, 2010d). Submerged vegetation can be physically removed, buried, or exposed to drastic salinity shifts after severe storm events (Maiaro, 2007). The recovery times for beds depend on the size of the disturbance (Fourqurean and Rutten, 2004). There has been little published on the possible effects of these storms on local submerged vegetation communities. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). As such, seagrass and SAV communities in the WPA are not believed to have been impacted by the DWH event.

In western Louisiana, just east of the WPA, submerged vegetation primarily consists of freshwater and low salinity SAV's. Largely due to the turbid water conditions that are caused by the Mississippi and Atchafalaya Rivers, seagrass beds in Louisiana have low densities and are rare. Many beds in Louisiana are continually affected by storm events of different severities, which dictate the possible recovery times because that is a function of the size of the disturbance (Fourqurean and Rutten, 2004). Strong storm events not only removed seagrass and SAV beds but also changed the nekton community structure (Maiaro, 2007).

4.1.1.5.2. Impacts of Routine Events

Background/Introduction

The routine events associated with OCS activities in the WPA that could adversely affect submerged vegetation communities include construction of pipelines, canals, navigation channels, and onshore facilities; maintenance dredging; and vessel traffic (e.g., propeller scars). Many of these activities would result in an increase of water turbidity that is detrimental to submerged vegetation health. Through avoidance and mitigation policies, these effects are generally localized, short-term, and minor in nature. Existing and projected lengths of OCS-related dredging, pipelines, and vessel activities are described in detail in Chapters 4.1.2.1.7 and 4.1.3.3.3 of the Multisale EIS and Chapter 3.1.2 of the 2009-2012 Supplemental EIS and in **Chapter 3.1** of this Supplemental EIS. The dynamics of how these activities impact submerged vegetation is discussed in Chapters 4.2.1.1.3.3 and 4.2.2.1.3.3 of the Multisale EIS and are summarized here.

Proposed Action Analysis

Dredging impacts associated with the installation of new navigation channels are greater than those for pipeline installations because it creates a much wider and deeper footprint. New canal dredging and related disposal of dredged material also cause significant changes in regional hydrology (Onuf, 1994; Collins, 1995; Erftemeijer and Lewis, 2006). Examples of this are the heavy traffic utilizing the Gulf Intracoastal Waterway and maintenance dredging that decreases local seagrass beds in Laguna Madre, Texas (Texas Parks and Wildlife Department, 1999). Deepwater oil and gas exploration requires larger vessels that could cause channel widening; however, the inshore facilities would probably remain the same. In Texas, examples of these inshore facilities are in Galveston, Freeport, and Port O'Connor (Table 3-31 of the Multisale EIS). In Louisiana, some are located in Cameron, Fourchon, Intracoastal, Morgan City, and Venice (Table 3-31 of the Multisale EIS). Channel dredging to facilitate, create, and maintain waterfront real estate, marinas, and waterways will continue to be a major impact-producing factor on the Gulf Coast. The waterway maintenance program of COE has been operating in the WPA for decades. Impacts generated by initial channel excavations are sustained by regular maintenance activities performed on average every 2-5 years. Maintenance activities are projected to continue into the future regardless of the OCS activities.

Dredge and fill activities are the greatest threats to submerged vegetation habitat (Wolfe et al., 1988). Effects from dredging and resuspension of sediments are relative to dredge type and sediment size (Collins, 1995). The most serious impacts generated by dredging activities to submerged vegetation and associated communities are a result of the removal of sediments, changes in salinity, burial of existing habitat, and oxygen depletion and reduced light associated with increased water turbidity (Erftemeijer and Lewis, 2006). Increased water turbidity from dredging operations that causes light attenuation will negatively affect the vegetation health (Onuf, 1994; Kenworthy and Fonseca, 1996). Suspension of the fine sediments from dredging activities may influence not only water clarity but also nutrient dynamics in estuaries, which can decrease overall primary production (Essink, 1999; Erftemeijer and Lewis, 2006). While these effects can decrease submerged vegetation cover, the activities would be localized and monitored events. Also, plans for installation of new linear facilities and maintenance dredging are reviewed by a variety of Federal, State, and local agencies and the interested public in order to receive the necessary government approvals. Mitigation may be required to reduce undesirable effects on beds from dredging activities. The most effective mitigation for direct impacts to submerged vegetation beds and associated communities is avoidance, but if contact is unavoidable, actions such as using turbidity curtains with a sizable barrier can mitigate dredge effects.

Pipeline construction in coastal waters could temporarily elevate water turbidity in submerged vegetation beds near the pipeline routes. The duration of increased water turbidity would depend on factors like currents, bottom topography, and substrate type (Collins, 1995). The COE and State permit requirements are expected to impose pipeline routes that avoid high-salinity beds, as well as reduce and maintain water turbidity within tolerable limits for submerged vegetation. About 250 active OCS pipelines currently cross the Federal/State boundary into State waters, of which over 100 make landfall. There are 80-118 new pipelines projected in State waters as a result of the OCS Program from 2007 to 2046. Of those, 6-8 are anticipated to make landfall in the WPA from the OCS Program through 2046. Most activities would use existing inshore structures, so at most one pipeline per year would make landfall. If any new pipelines run to shore due to the WPA proposed action, environmental permit requirements for locating pipelines would result in minimal impact on seagrasses. Because of regular tidal flushing, increased water turbidity from pipeline activities is projected to be below significant levels. Therefore, effects on submerged vegetation from pipeline installation are predicted to be small and short term.

Vessel traffic would only pose a risk to seagrasses when near shore and to SAV when inshore. Submerged vegetation beds near active navigation channels would already be altered physically by regularly occurring associated activities. Because of the depths where major vessel traffic occurs, propeller wash would not resuspend sediments in navigation channels beyond pre-project conditions. Little, if any, damage to submerged vegetation beds would occur as a result of typical channel traffic. Scarring of seagrass beds by vessels (e.g., support vessels for OCS and State oil and gas activities, fishing vessels, and recreational watercraft) is an increasing concern along the Texas coast (Dunton et al., 1998; Texas Parks and Wildlife Department, 1999; Pulich and Onuf, 2007). Scarring most commonly occurs in water depths less than 2 m (~6 ft) as a result of boats operating in too shallow water (Zieman, 1976; Sargent et al., 1995; Dunton et al., 1998). Consequently, their propellers and occasionally their keels plow through vegetated bottoms tearing up roots, rhizomes, and whole plants, leaving a furrow that is devoid of submerged vegetation (Zieman, 1976; Dawes et al., 1997). This can ultimately destroy the beds, which are essential nursery habitat for many species (Heck et al., 2003; Orth et al., 2006). The recovery period from scarring varies with the width of the scar, type of scarring, sediment, water quality, and species (Zieman, 1976; Durako et al., 1992; Sargent et al., 1995). If a bed has extensive damage or if an already stressed bed is damaged, it could take decades to recover. Scarring may have a more critical effect on habitat functions in areas with less submerged vegetation, like those found in Louisiana. The

State of Texas, with the help and support of Texas Parks Service, Texas General Land Office, researchers, and sportsmen has instituted management programs to reduce scarring (Texas Parks and Wildlife Department, 1999). These programs include education, channel marking, increased enforcement, and limited-motoring zones. Initial monitoring results indicate that scarring seems to be declining in protected areas. There would be little reason for an OCS vessel to anchor or stop in areas that are not designated ports or work structures; therefore, it would be rare for these vessels to be in areas populated by vegetation.

Summary and Conclusion

Routine OCS activities in the WPA that may impact seagrasses are not predicted to significantly increase in occurrence and range in the near future, with minimal associated nearshore activities and infrastructure, such as the projected one new pipeline landfall. Requirements of other Federal and State programs, such as avoidance of the seagrass and vegetation communities or the use of turbidity curtains, reduce undesirable effects on submerged vegetation beds from dredging activities. Federal and State permit requirements should ensure that pipeline routes avoid high-salinity beds and maintain water clarity and quality. Local programs decrease the occurrence of prop scarring in grass beds, and channels utilized by OCS vessels are generally away from exposed submerged vegetation beds. Because of these requirements and implemented programs, along with the beneficial effects of natural flushing (e.g., from winds and currents), any potential effects from routine activities on submerged vegetation in the WPA are expected to be localized and not significantly adverse.

4.1.1.5.3. Impacts of Accidental Events

Background/Introduction

A detailed analysis of accidental impacts upon seagrass communities can be found in Chapter 4.4.3.3 of the Multisale EIS and in Chapter 4.1.3.3.3 of the 2009-2012 Supplemental EIS. The following is a summary of that information and any new information discovered through recent literature searches since both documents were prepared.

Proposed Action Analysis

Within the WPA, much of the seagrass cover is in Texas and located in the Laguna Madre (Onuf, 1996; Texas Parks and Wildlife Department, 1999; Pulich and Onuf, 2006). There are also lower-salinity SAV beds inland and discontinuously in Texas' coastal lakes, rivers, and the most inland portions of some coastal bays (Texas Parks and Wildlife Department, 1999). In Louisiana, submerged vegetation primarily consists of freshwater and low-salinity vegetation (SAV), but there are seagrass beds in the vicinity of the Chandeleur Island chain (Poirrier, 2007).

Accidental events possible with the WPA proposed action that could significantly adversely affect submerged vegetation beds include nearshore and inshore spills connected with the transport and storage of oil. Offshore oil spills that occur in the proposed action area are less likely to contact seagrass communities than are inshore spills because the seagrass beds are generally protected by barrier islands, peninsulas, sand spits, and currents. However, if the temporal and spatial duration of the spill is massive, an offshore spill could affect submerged vegetation communities, as seen with the DWH event.

The probabilities of a spill ≥1,000 bbl occurring related to the OCS Program and contacting environmental features are described in Chapter 4.3.1.5 of the Multisale EIS. The total estimated number of offshore spill events ranging from 0 to ≥10,000 bbl over the 40-year life of the proposed WPA action is 767-1,462 spills (**Table 3-5**). The risk of an offshore spill ≥1,000 bbl occurring and contacting coastal counties and parishes was calculated by BOEMRE's oil-spill trajectory model (Chapter 4.3.1.5 of the Multisale EIS). Counties and parishes are used as an indicator of the risk of an offshore spill reaching sensitive coastal environments, and this is the point when oil could contact the submerged community. Figure 4-13 of the Multisale EIS provides the results of the OSRA model that calculated the probability of a spill ≥1,000 bbl occurring offshore as a result of the WPA proposed action and reaching a Gulf Coast parish or county.

Most of the counties and parishes are at minimum risk of being contacted; the most frequently calculated probability of a spill contacting their shorelines is less than 0.5 percent. Six counties in Texas have a chance of spill contact greater than 0.5 percent, with Matagorda having the greatest probability of 5 percent; the other counties have less than a 5 percent chance of an OCS offshore spill ≥1,000 bbl occurring. One parish in Louisiana (Cameron) has a chance of spill contact that is greater than 0.5 percent. For this parish, the chance of an OCS offshore spill ≥1,000 bbl occurring and reaching its shoreline is 1 percent. The probability of an oil spill ≥1,000 bbl contacting the State offshore waters within 10 days and contacting some submerged vegetation in Texas is 10-16 percent and in Louisiana is 1-2 percent from the WPA (Figure 4-15 of the Multisale EIS). Inshore spills may result from either vessel collisions or ruptured pipelines that release crude and condensate oil. The Galveston/Houston/ Texas City area has the greatest risk of experiencing coastal spills related to the WPA proposed action (Chapter 4.3.1.7.2 of the Multisale EIS). Because of the floating nature of nondispersed crude oil, the regional microtidal range, dynamic climate with mild temperatures, and the amount of micro-organisms that consume oil, these spills would typically be short-term events and have little prolonged effects on submerged vegetation communities and the associated fauna (DeLaune et al., 1990; Roth and Baltz, 2009). Increased water turbulence from waves, storms, or vessel traffic breaks apart the surface oil sheen and disperses some oil into the water column or oil mixed with sediments, which can settle and coat the entire plant with oil and sediments (Teal and Howarth, 1984; Thorhaug, 1988; Burns et al., 1994). This coating situation also happens when oil is treated with dispersants because the dispersants break down the oil and it sinks into the water column. However, as reviewed in Runcie et al. (2004), oil mixed with dispersants has shown an array of effects on seagrass depending on the species and dispersant used.

An offshore spill would inundate the coastal waters first and effect local communities similar to an inshore spill. With a greater distance from shore, there is a greater chance of the oil being weathered by natural and mechanical processes by the time it reaches the nearshore habitat.

If an oil slick settles into a protective embayment where submerged vegetation beds are found, decreased water clarity from coating and shading causes reduced chlorophyll production and could lead to a decrease in vegetation (Erftemeijer and Lewis, 2006). Depending on the species and environmental factors (e.g., temperature and wave action), seagrasses may exhibit minimal impacts from a spill; however, communities residing within the beds could accrue greater negative outcomes (den Hartog and Jacobs, 1980; Jackson et al., 1989; Kenworthy et al., 1993; Taylor et al., 2006). Community effects could range from direct mortality due to smothering or indirect mortality from loss of food sources and habitat to a decrease in ecological performance of the entire system depending on the severity and duration of the spill event (Zieman et al., 1984). Because different species have different levels of sensitivity to oil, it is difficult to compare studies and extrapolate what variables caused the documented differences in vegetation and community health (Thorhaug et al., 1986; Runcie et al., 2004).

Prevention and cleanup efforts could also affect the health of submerged vegetation communities (Zieman et al., 1984). Many physical prevention methods such as booms, barrier berms, and diversions can alter hydrology, specifically changing salinity and water clarity. These changes would harm seagrasses because they are tolerant to certain salinities and light levels (Zieman et al., 1984; Kenworthy and Fonesca, 1996). There is increased boat and human traffic in these sensitive areas that are generally protected from this degree of human disturbance prior to the response. Increased vessel traffic would lead to elevated water turbidity and increased prop scarring. While the elevated levels of water turbidity would be short term and the possible damages from propellers could be longer, both events would be localized during the prevention and cleanup efforts (Zieman, 1976; Dawes et al., 1997). Detailed sampling to evaluate the effects of the DWH event and associated prevention/cleanup efforts are occurring within the NRDA process. The information that is available since the DWH event and that is about the current state of the submerged vegetation in Texas and Louisiana is found in **Chapter 4.1.1.5.1** in this Supplemental EIS.

Summary and Conclusion

Although the probability of their occurrence is low, the greatest threat to inland, submerged vegetation communities would be from an inland spill resulting from a vessel accident or pipeline rupture. The resulting slick may cause short-term and localized impacts to the bed. There is also the remote possibility of an offshore spill to such an extent that it could also affect submerged vegetation beds, and this would have similar effects to an inshore spill. Because prevention and cleanup measures can have negative effects on submerged vegetation, close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize those impacts. The floating nature of nondispersed crude oil, the regional microtidal range, dynamic climate with mild temperatures, and the amount of microorganisms that consume oil would alleviate prolonged effects on submerged vegetation communities. Also, safety and spill-prevention technologies continue to improve and will decrease the detrimental effects to submerged vegetation from the WPA proposed action.

4.1.1.5.4. Cumulative Impacts

Background/Introduction

A detailed impact analysis for cumulative impacts in the WPA on submerged vegetation can be found in Chapter 4.5.3.3 of the Multisale EIS and in Chapter 4.1.3.3.1 of the 2009-2012 Supplemental EIS. The following is a summary of those analyses, and it incorporates any new information that has become available since both documents were prepared. Of all of the activities in the cumulative scenario found in **Chapter 3.3** of this Supplemental EIS, dredging, oil spills/pipelines, hydrological changes, and storm events present the greatest threat of impacts to submerged vegetation communities.

Generally, dredging generates the greatest overall risk to submerged vegetation by uprooting and burying plants, decreasing oxygen in the water, and reducing water clarity in an area. Increased dredging in the WPA is expected only in areas that do not support submerged vegetation beds. Maintenance dredging would not have a substantial effect on existing seagrass habitat given that no new channels are expected to be dredged as a result of OCS activities in the WPA. Another anthropogenic activity that could cause adverse effects to submerged vegetation is accidental oil-spill events. These are generally rare and small-scale, but they do add to the possible cumulative damage to the submerged vegetation systems. Finally, historic and some recent construction of structures like levees and berms change local hydrology and that can affect submerged vegetation beds. There has also been an increase in tropical cyclone events in the Atlantic. Hurricanes generate substantial overall risk to submerged vegetation by burial and eroding channels through seagrass beds. When combined with other stresses, impacted seagrass beds may fail to recover.

In support of inshore petroleum development, the oil and gas industry and land developers perform most of the dredging that impacts lower-salinity submerged vegetation in Texas and Louisiana. Mitigation may be required to reduce undesirable impacts of dredging to submerged vegetation. Maintenance dredging of navigation channels helps sustain the impacts of original dredging. From 2007 to 2046, offshore oil and gas activities are projected to generate another 6-8 pipeline landfalls in Texas and 25-36 pipeline landfalls in Louisiana; this is equivalent to less than 1 pipeline a year (Table 4-9 of the Multisale EIS). The most effective mitigation for direct impacts to submerged vegetation beds is avoidance, but there are other mitigation techniques in place to lessen the effects unavoidable disturbances.

Inshore oil spills generally present a greater risk of adversely impacting submerged vegetation and seagrass communities than do offshore spills with regards to OCS activities in the WPA. Although little to no direct permanent mortality of seagrass beds is expected as a result of oil-spill occurrences, contact of seagrasses with crude and refined oil has been implicated as a cause of the decline in plant biomass and cover, and a cause of the observed changes in species composition within them (Zieman et al., 1984; Erftemeijer and Lewis, 2006). Because nondispersed oil floats and because of the local microtidal range, oil spills alone would typically have little impact on submerged vegetation beds and associated epifauna. During and after a spill event, the cleanup effort can cause significant scarring and trampling of submerged vegetation beds with increased traffic in the area. Also, preventative measures (booms, berms, and diversions) can alter water hydrology and salinity, which could harm the beds and their associated communities.

Many of man’s activities have caused landloss either directly or indirectly by accelerating natural processes. Natural drainage patterns along the Texas coast have been severely altered by construction of the Gulf Intracoastal Waterway and other associated channelization projects. Floodwaters laid down sediment over the active Mississippi River deltaic plain, and this accretion countered ongoing submergence and also built new land. However, the river was channelized and leveed in the early 1900’s. Because of this anthropogenic effect, areas that did not receive sediment-laden floodwaters continually lost elevation. Further compounding this effect, the suspended sediment load in the Mississippi River has decreased more than 50 percent since the 1950's, largely as a result of dam and reservoir construction and soil conservation practices in the drainage basin (Turner and Cahoon, 1988).

Saltwater intrusion as a result of river channelization and canal dredging is a major cause of coastal habitat deterioration (including submerged vegetation communities) (Boesch et al., 1994). Productivity and species diversity associated with SAV habitat in the coastal marshes of Texas and Louisiana are greatly reduced by saltwater intrusion (Stutzenbaker and Weller, 1989; Lirman et al., 2008). Due to increased salinities farther up the estuaries, some salt-tolerant species of submerged vegetation (including seagrasses) are able to populate areas farther inland and outcompete the dominant SAV species (Longley, 1994). Large shifts in salinities can decrease both seagrass and SAV populations, which decreases their ecological function for juvenile fishes and invertebrates. An example of a salinity shift that occurs in Louisiana is the opening of the Bonnet Carré Spillway to divert the Mississippi River flood waters into Lake Pontchartrain during high-water stages. This freshwater eventually flows into Mississippi and Chandeleur Sounds, lowering salinities there. In the past, spillway openings have been associated with a noticeable decrease in seagrass vegetation acreage (Eleuterius, 1987). Conversely, the Caernarvon Freshwater Diversion into the Breton Sound Basin, east of the River, provides more regular flooding events, which have reduced average salinities there. Reduced salinities there have triggered a large increase in acreage of submerged aquatic vegetation like *R. maritima* (Cho et al., 2009).

When the Mississippi River is in flood condition, floodways may be opened to alleviate the threat of levee damage. The floodways of the Mississippi River direct water to estuarine areas where flood waters may suddenly reduce salinities for a couple of weeks to several months. This lower salinity can damage or kill high-salinity seagrass beds if low salinities are sustained for longer periods than the seagrass species can tolerate (Eleuterius, 1987). Opening one of the floodways of the Mississippi River is the single action that can adversely impact the largest areas of higher-salinity submerged vegetation.

Submerged vegetation communities can be scarred by boat anchors, keels, and propellers, and by activities such as trampling, trawling, and seismic surveys (Sargent et al., 1995; Dunton et al., 1998). Loggerhead turtles, other large animals, and storm events can scar vegetated bottoms. A few State and local governments have instituted management programs that have resulted in reduced scarring, which could decrease bed patchiness (Texas Parks and Wildlife Department, 1999).

Currently, there is a period of significant increased tropical cyclone activity in the Gulf of Mexico. These storms can remove or bury submerged beds and the barriers that protect them from storm surges. This could weaken the existing populations of local submerged vegetation. Seagrass beds have been repeatedly damaged by the natural processes of transgression from hurricane overwash of barrier islands. Storm-generated waves wash sand from the seaward side of the islands over the narrow islands and cut new passes through the islands. The overwashed sand buries seagrass beds on the back side of the islands. Cuts formed in the islands erode channels that remove seagrass in its path. Over time, seagrass recolonizes the new sand flats on the shoreward side, and the natural processes of sand movement rebuild the islands. Hurricane impacts can produce changes in seagrass community quality and composition. These increased tropical cyclone events coincide with the current period of global climate changes. Global climate change can increase surface temperature, increase sea levels, and increase storm events (Orth et al., 2006). Whether it is from anthropogenic activities or a cycle, it has effects on seagrass beds by adding stress to this sensitive and already stressed ecosystem (Orth et al., 2006).

Summary and Conclusion

In general, the WPA proposed action would cause a minor incremental contribution to impacts on submerged vegetation from dredging, pipeline installations, potential oil spills, and boat scarring. Dredging generates the greatest overall risk to submerged vegetation, while naturally occurring hurricanes cause direct damage to beds. The implementation of proposed lease stipulations and mitigation policies currently in place, the small probability of an oil spill, and that flow regimes are not expected to change further reduce the incremental contribution of stress from the WPA proposed action to submerged vegetation.

4.1.1.6. Topographic Features

The BOEMRE has protected topographic features that support sensitive benthic communities since the early 1970's. The Gulf of Mexico seafloor in the WPA is mostly mud bottoms with varying mixtures of sand in some areas. Due to periods of lower sea level in geologic history, a thick layer of salt is present in a stratum deep beneath the seafloor. This salt becomes liquid under high pressure and pushes its way up through faults in the seafloor. In doing so, it sometimes forces up rock strata to form a "salt diapir" protruding up above the surrounding soft-bottom seafloor. Wherever these upthrusts of rock protrude into the water column, they form a rock reef that supports reef organisms that are different from those on typical soft bottoms. These reefs are relatively rare on the seafloor compared with the ubiquitous soft bottoms (Parker et al., 1983). Some other banks, such as the south Texas banks, are relic coral reefs left over from the last sea-level low stand (about 10,000 years ago). These topographic highs, or subsea banks, provide an island of hard substrate in a virtual ocean of soft bottoms. As a result, reef communities develop and include many of the more sensitive species associated with Caribbean waters.

"Topographic features" is a term that specifically refers to 37 subsea banks in the GOM that are protected from potential impacts by oil and gas activities. They are defined in this Agency's NTL 2009-039, "Biologically-Sensitive Underwater Features and Areas," as "isolated areas of moderate to high relief that provide habitat for hard-bottom communities of high biomass and diversity and large numbers of plant and animal species, and support, either as shelter or food, large numbers of commercially and recreationally important fishes."

Over time, knowledge of these communities has increased and protective measures have evolved. This Agency has conducted environmental studies in the GOM for the past 35 years. Protective measures were instituted based on the nature and sensitivity of bank habitats and their associated communities. These protections have developed into stipulations applied to OCS leases. The lease stipulations establish five categories of protection zones: No Activity Zone; 1,000-Meter Zone; 1-Mile Zone; 3-Mile Zone; and the 4-Mile Zone. The No Activity Zone surrounds the core of the bank and prohibits any contact with the seafloor. The other zones are buffers with restrictions on the discharge of drill cuttings. All 37 banks have the No Activity Zone and may have up to two of the other zones. Details of the restrictions are described in this Agency's NTL 2009-G39. The Biological Stipulation Map Package (https://www.boemre.gov/homepg/regulate/regs/ntls/2009NTLs/09-G39.pdf) includes drawings of each bank with associated protection zones.

The BOEMRE has reexamined the analysis for topographic features presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below. New information supports the previous assessments contained in the Multisale EIS. Results of searches that were conducted for available data indicating the impacts to topographic features as a result of the DWH event have also been included in this assessment. The full analyses of the potential impacts of routine activities, accidental events, and cumulative impacts associated with the WPA proposed action are presented in the Multisale EIS. A summary of those analyses and their reexamination due to new information is presented in the following sections.

Note that, although the Flower Garden Banks National Marine Sanctuary is discussed below in the impacts analysis, neither of the Action alternatives for the proposed lease sale would offer any full or partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary.

4.1.1.6.1. Description of the Affected Environment

A detailed description of topographic features can be found in Chapter 3.2.2.1.2 of the Multisale EIS. A search was conducted for additional new information published since completion of the Multisale EIS and the 2009-2012 Supplemental EIS. Various Internet sources and journal articles were examined to discover any recent information regarding topographic features. Sources investigated include USGS, NOAA, USEPA, and coastal universities. Other sites were found through general Internet searches. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Topographic features are hard-bottom habitats and are rare compared with the ubiquitous soft bottoms in the GOM (Parker et al., 1983). They are typically upthrusts of rock due to uplift (salt diapirs) by underlying layers of salt deep under the seafloor. Some others, such as the South Texas Banks, are relic coral reefs left over from the last sea-level low stand (about 10,000 years ago). These topographic highs, or subsea banks, provide an island of hard substrate in a virtual ocean of soft bottoms.

Wherever rock protrudes up into the water column, reef organisms thrive. The type of organisms inhabiting a reef is determined by environmental conditions. Major factors are the amount of light and sedimentation and the temperature. If conditions are very good, a coral reef is established; this is found in the WPA only at the Flower Garden Banks. Other reefs (rocky upthrusts) are too dark or have too much sedimentation for hermatypic (reef-building) corals to thrive in numbers adequate to build a coral reef. However, these deeper reefs have thriving communities that include some stony corals as well as gorgonians, black corals, soft corals, sponges, urchins, crabs, many other invertebrates, macroalgae, calcareous algae, and a healthy fish community. The characteristics of protected topographic features in the GOM are described in more detail below.

The habitat created by the topographic features and the organisms found upon them is important for the following reasons:

- they support hard-bottom communities of high biomass, high diversity, and high numbers of plant and animal species;
- they provide shelter, food, and nursery grounds that support large numbers of commercially and recreationally important fishes;
- they are a unique and valuable component of the much larger ecosystem, providing essential functions not available elsewhere;
- they provide a relatively pristine area suitable for scientific research (especially the East and West Flower Garden Banks); and
- they have an aesthetically intrinsic value.

Figure 4-4 depicts the location of protected topographic features in the GOM. In 1998, USGS, in cooperation with BOEMRE and the Flower Garden Banks National Marine Sanctuary, surveyed the East and West Flower Garden Banks using high-resolution, multibeam mapping techniques (Gardner et al., 1998). In 2002, the same consortium mapped 12 more topographic features, including Rankin (1 and 2) and MacNeil Banks in the WPA (Gardner et al., 2002).

A total of 22 topographic features are protected in the WPA. The BOEMRE has created “No Activity Zones” around major topographic features in order to protect these habitats from disruption due to oil and gas activities. A “No Activity Zone” is a protective perimeter associated with a specific depth contour that is drawn around each feature; no contact with the seafloor is allowed including the placement of structures, drilling rigs, pipelines, anchoring, and cables. These No Activity Zones are areas protected by BOEMRE policy. The NTL 2009-G39 also recommends that drilling would not occur within 152 m (500 ft) of a No Activity Zone of a topographic feature. This additional recommendation is based on essential fish habitat; any construction within the buffer would require project-specific consultation with NOAA.

The surveys conducted by Gardner et al (1998 and 2002) revealed complex bathymetry in some areas surrounding the banks outside the No Activity Zones. Small seafloor features of moderate to high relief (8 ft [2.4 m] or higher) outside of the No Activity Zones of the larger banks are called “potentially sensitive biological features” and are considered important fish habitat. The potentially sensitive biological features provide surface area for the growth of sessile invertebrates and attract large numbers of fish. They are protected by BOEMRE from impacts of oil and gas activities as described by NTL 2009-G39 in that no bottom-disturbing activities may cause impacts to potentially sensitive biological features.

Benthic organisms on topographic features are mainly limited by temperature, sedimentation, and low light. Extreme water temperature and light intensity are known to stress corals. Temperatures lower than 16 ^{o}C (60.8 °F) reduce coral growth, while temperatures in excess of 34.4 ^{o}C (93.2 °F) impede coral growth and induce coral bleaching (loss of symbiotic zooxanthellae) (Kleypas et al., 1999). While intertidal corals are adapted to high light intensity, most corals become stressed when exposed to unusually high light levels. Furthermore, although corals will grow or survive under low light level conditions, they do best submerged in clear, nutrient-poor waters (Kleypas et al., 1999).

Light penetration in the Gulf is limited by several factors, including depth and events of prolonged turbidity. Hard substrates favorable to colonization by hermatypic coral communities in the northern Gulf are found on outer shelf, high-relief features. These substrates protrude above the nepheloid layer (layer of high turbidity) that lies close to the muddy seafloor and are bathed most of the year in nutrient-poor waters (Rezak et al., 1990). The East and West Flower Garden Banks (**Figure 4-4**) are the principal examples of such suitable substrates. Average turbidity values at the Flower Garden Banks (<11 nephelometric units) correspond to turbidity levels that do not affect the photosynthesis and respiration of hermatypic corals (Precht et al., 2006). The depth of these banks (15 m [49 ft] or more below the sea surface) reduces the effects of storms on the habitats. Whereas typical Caribbean shore reefs can suffer extensive damage from tropical storms, only wave influence from the strongest storms can reach reefs in the GOM. The most common influence of strong storms on these banks is an increase in turbidity, generally at the lower levels of the banks (Rezak et al., 1990). Turbidity and sedimentation are normal in these lower levels because of the nepheloid layer and normal resuspension of soft bottom sediments.

Gulf of Mexico reefs span a range of environments, resulting in a range of community types. Habitats that can be classified as true coral reefs are few in the northern GOM: limited to the East and West Flower Garden Banks; a small area of McGrail Bank; and part of Pulley Ridge (in the eastern GOM). Other banks support reef communities with varying degrees of diversity, depending on environmental conditions. Many of these harbor a variety of corals, including some hermatypic corals, but not in densities that build a thriving, accreting coral reef. The banks of the GOM have been identified and classified into seven distinct biotic zones (Table 3-3 of the Multisale EIS) (modified/updated from Rezak and Bright, 1981; Rezak et al., 1983); however, none of the banks contain all seven zones. The zones are divided into the following four categories depending upon the degree of reef-building activity in each zone.

Zones of Major Reef Building and Primary Production

Diploria-Montastraea-Porites Zone

This zone is characterized by 18-20 hermatypic coral species and is found predominantly at the East and West Flower Garden Banks (**Figure 4-4**). The dominant species/groups of the zone in order of dominance are the *Montastraea annularis* complex (this group includes *M. franksi*, *M. faveolata*, and *M. annularis*), *Diploria strigosa*, *Porites astreoides*, and *Montastraea cavernosa* (Precht et al., 2008; Robbart et al., 2009). Coralline algae are abundant in areas, which adds substantial amounts of calcium carbonate to the substrate and serves to cement the reef together. In addition to the coralline algae, there is a considerable amount of bare reef rock, which fluctuates in percent cover with the appearance of a red-turf like algae, at both banks. Red turf algae (primarily Order Ceramiales) is the dominant algal group at the East and West Flower Garden Banks and has increased in percent cover substantially over the last several years. Dokken et al. (2003) reported algal percent cover at both banks was significantly greater during 1999 than during 1998. Macroalgal cover was reportedly high in 2005 and increased in 2006 after the passing of Hurricane Rita (Precht et al., 2008; Robbart et al., 2009). Monitoring of random transects on the East and West Flower Garden Banks before Hurricane Rita indicated that percent coral cover was between 50 percent and 65 percent, which was similar to overall coverage after the passing of the storm and through surveys in 2007 (Precht et al., 2008; Robbart et al., 2009; Cadlow et al., 2009). There was evidence, however, of high levels of bleaching (up to 46% of individual colonies) in 2005 due to elevated water temperatures, which was significantly reduced (4%) the following year (Hickerson et al., 2008). Historical data indicate recovery after such events and overall community stability (Gittings, 1998; Precht et al., 2008).

Typical sport and commercial fish and invertebrates observed in this zone include various grouper species; amberjack; barracuda; red, gray, and vermilion snapper; cottonwick; porgy; spiny lobsters; and shovel-nosed lobster (Rezak et al., 1983). There is also a diverse group of tropical reef fish species found on these banks, including creole fish; queen, stoplight, red band, and princess parrot fish; rock beauty; blue tang, and the whitespotted filefish, just to name a few. There are over 175 tropical reef species that reside within the high-diversity zone at the Flower Garden Banks (Dennis and Bright, 1988; Pattengill, 1998). This high-diversity *Diploria/Montastraea/Porites* Zone is found only at the East and West Flower Garden Banks in water depths less than 36 m (118 ft) (Rezak et al., 1990).

Madracis and Fleshy Algal Zone

The *Madracis* Zone is dominated by the small branching coral *Madracis mirabilis*, which produces large amounts of carbonate sediment (Rezak et al., 1990). In places, large (possibly ephemeral) populations of turf-like algae dominate the *Madracis* gravel substratum (Algal Zone). The *Madracis* Zone appears to have a successional relationship with the *Diploria-Montastraea-Porites* Zone. *Madracis* colony rubble builds up the substrate and allows the successional species to grow (Rezak et al., 1983). The zone occurs at the East and West Flower Garden Banks on peripheral components of the main reef structure between 28 and 46 m (92 and 151 ft) (Rezak et al., 1990).

Stephanocoenia-Millepora Zone

The *Stephanocoenia-Millepora* Zone is inhabited by a low-diversity coral assemblage of 12 hermatypic corals and can be found at the Flower Garden Banks. The eight most conspicuous corals in order of dominance are *Stephanocoenia michelini, Millepora alcicornis*, *Montastraea cavernosa*, *Colpophyllia natans*, *Diploria strigosa*, *Agaricia agaricites*, *Mussa angulosa*, and *Scolymia cubensis* (Rezak et al., 1983). The assemblages associated with this zone are not well known; coralline algae is the dominant organism in the zone. The American thorny oyster (*Spondylus americanus*) is common in this zone along with populations of some reef fish (Rezak et al., 1983). The depth range of this zone is between 36 and 52 m (118 and 171 ft) (Rezak et al., 1990).

Algal-Sponge Zone

The Algal-Sponge Zone covers the largest area among the reef-building zones. The dominant organisms of the zone are the coralline algae, which are the most important carbonate producers. The algae produce nodules called "rhodoliths," which are composed of over 50 percent coralline algae, and form large beds on the seafloor. The rhodoliths range from 1 to 10 cm (0.4 to 4 in) in size, cover 50-80 percent of the bottom, and generally occur in water depths between 55 and 85 m (180 and 280 ft) (Rezak et al., 1983). The habitat created by the alga nodules supports communities that are probably as diverse as the coral-reef communities. Most of the leafy algae found on the banks occur in this zone and contribute large amounts of food to the surrounding communities. Calcareous green algae (*Halimeda* and *Udotea)* and several species of hermatypic corals are major contributors to the substrate (Rezak et al., 1983). Deepwater alcyonarians are abundant in the lower Algal-Sponge Zone. Sponges, especially *Neofibularia nolitangere,* are conspicuous. Echinoderms are abundant and also add to the carbonate substrate. Small gastropods and pelecypods are abundant (Rezak et al., 1983). Gastropod shells are known to form the center of some of the algal nodules. Characteristic fish of the zone are yellowtail reef fish, sand tilefish, cherubfish, and orangeback bass (Rezak et al., 1983).

Partly drowned reefs are a major substrate of the Algal-Sponge Zone. They are shallow carbonate reefs that are outpaced by sea-level rise and subsidence (Schlager, 1981). Their accumulation of carbonate is slower than relative sea-level rise so that, over time, they are found deeper and deeper in the water until they are no longer an accreting coral reef. In addition to the organisms typical to the rest of the Algal-Sponge Zone, the partly drowned reefs are also inhabited by large anemones, large comatulid crinoids, basket stars, limited crusts of *Millepora*, and infrequent small colonies of other hermatypic species (Rezak et al., 1983). The relief and habitat provided by the carbonate structures also attract a variety of fish species, especially yellowtail reef fish, reef butterfly fish, spotfin hogfish, orangeback bass, cherubfish, wrasse bass, longjaw squirrelfish, and several grouper species (Dennis and Bright, 1988).

Zone of Minor Reef Building

Millepora-Sponge Zone

The *Millepora*-Sponge Zone occupies depths comparable to the *Diploria-Montastraea-Porites* Zone on the claystone-siltstone substrate of the Texas-Louisiana midshelf banks. Crusts of the hydrozoan coral, *Millepora alcicornis*, sponges, and other epifauna occupy the tops of siltstone, claystone, or sandstone outcrops in this zone. Scleractinian corals and coralline algae are rarely observed, largely due to seasonal temperatures that drop below the 18 °C (64 °F) minimum requirement for vigorous coral reef growth (Rezak et al., 1990).

Transitional Zone of Minor to Negligible Reef Building

Antipatharian Zone

This transitional zone is not distinct but blends in with the lower Algal-Sponge Zone. It is characterized by an abundance of antipatharian whips growing with the algal-sponge assemblage (Rezak et al., 1983). With increased water depth, the assemblages of the zone become less diverse, characterized by antipatharians, comatulid crinoids, few leafy or coralline algae, and limited fish (yellowtail redfish, queen angelfish, blue angelfish, and spotfin hogfish). Again, the depth of this zone differs at the various banks but generally extends to 90-100 m (295-328 ft) (Rezak et al., 1990).

Zone of No Reef Building

Nepheloid Zone

High turbidity, sedimentation, and resuspension occur in this zone. Rocks or drowned reefs are covered with a thin veneer of sediment, and epifauna are scarce. The most noticeable organisms are comatulid crinoids, octocoral whips and fans, antipatharians, encrusting sponges, and solitary ahermatypic corals (Rezak et al., 1990). The fish fauna is different and less diverse than those of the coral reefs or partly drowned reefs. These fish species include red snapper, Spanish flag, snowy grouper, bank butterflyfish, scorpionfishes, and roughtongue bass (Rezak et al., 1983). This zone occurs on all banks, but its depth differs at each bank. Generally, the Nepheloid Zone begins at the limit of the Antipatharian Zone and extends to the surrounding soft bottom (Rezak et al., 1990).

Banks of the Western Planning Area

Shelf-Edge Banks	Midshelf Banks	South Texas Banks
Appelbaum Bank	29 Fathom Bank	Aransas Bank
East Flower Garden Bank	32 Fathom Bank	Baker Bank
MacNeil Bank	Claypile Lump	Big Dunn Bar
Rankin Bank	Coffee Lump	Blackfish Ridge
West Flower Garden Bank	Stetson Bank	Dream Bank
		Hospital Bank
		Mysterious Bank
		North Hospital Bank
		Small Dunn Bar
		South Baker Bank
		Southern Bank

Figures 3-6 and 3-7 of the Multisale EIS illustrate the topographic relief associated with several of the more developed features, i.e., the East and West Flower Garden Banks and Stetson Bank.

Shelf-Edge Banks

The shelf-edge banks of the WPA generally exhibit the *Diploria-Montastraea-Porites* zonation that is exhibited at the East and West Flower Garden Banks at comparable depths (Rezak et al., 1983) (See **Figure 4-4** of this Supplemental EIS and Figure 3-6 of the Multisale EIS for the location and vertical relief of the banks.). Dominant coral species include *Montastraea annularis*, *Diploria strigosa*, *Montastraea cavernosa*, *Colpophyllia* spp., and *Porites astreoides* (Rezak et al., 1983). Crustose corraline algae and many species or reef fish are abundant in this zone. The dominant species transition below the 36- to 38-m (118- to 125-ft) depth, in the Stephanocoenia-Millepora Zone to *Stephanocoenia michelini*, *Millepora* spp., *Montastraea cavernosa*, *Colpophyllia* spp., *Diploria* sp., *Agaricia* spp., *Mussa angulosa*, and *Scolymia* sp. Crustose corraline algae, black urchin, and American thorny oyster are also present. Leafy algae (*Stypopodium*, *Caulerpa*, *Dictyota*, *Chaetomorpha*, *Pocockiella*, *Rhodymenia*, *Valonia*, and *Codium*) and the branching coral, *Madracis mirabilis*, may also be present in the Leafy Algae and Madracis Zones, at depths of 28-46 m (118-125 ft) on these Banks (Rezak et al., 1983). Between 46 and 82 m (151 and 269 ft), the Algal-Sponge Zone persists and is dominated by coralline algae that form rhodoliths upon which other organisms attach. Calcareous green algae, hermatypic corals, deepwater alcyonarians, antipatharian whips, sponges, and echinoderms are all present in this zone (Rezak et al., 1983). This section is a partially drowned reef environment, as it is at a depth where hermatypic corals have limited growth abilities. Drowned reefs, at depths too great for hermatypic coral growth and limited coralline algal growth, are below the Algal-Sponge Zone and consist of Comatulid crinoids, deepwater octocoral whips, octocoral fans, antipatharians, encrusting sponges, and solitary ahermatypic corals (Rezak et al., 1983). The water is generally turbid in this Antipatharian Zone and the reef is covered with sediment. Species numbers and diversity decrease with depth (Rezak et al., 1983).

Midshelf Banks

Three midshelf banks in the WPA contain the *Millepora*-Sponge Zone: Stetson; Claypile; and 29 Fathom Banks (**Figure 4-4)**. The nepheloid layer often enfolds Claypile Bank, which is considered a low-relief bank with only 10 m (33 ft) of relief. Therefore, the level of development of the *Millepora*-Sponge community is lowest at Claypile Bank. Low growing leafy and filamentous algae, including attached *Sargassum*, have been observed on Claypile Bank, along with a few large coral heads of *Stephanocoenia michelini* (Rezak et al., 1983). Two other midshelf banks in the WPA (32 Fathom Bank and Coffee Lump) are also low-relief banks with less than 10 m (33 ft) of relief. Coffee Lump Bank is predominated by antipatharian whips, comatulid crinoids, encrusting coralline algae, sponges, hydroids, serupilid worms, and hermatypic agariciid corals, and are often covered with a sediment veneer (Rezak et al., 1983).

Stetson Bank (**Figure 4-4**) is isolated from other banks and lies near the northern physiological limit for the advanced development of reef-building hermatypic corals. The species composition is markedly different from that of other tropical reefs including the Flower Garden Banks. In addition to the *Millepora*-Sponge characteristics at Stetson Bank, there are sparsely distributed reef- and nonreef-building coral species found. Ahermatypic, nonreef-building, corals (*Madracis decactus* and *Agaricia fragilis*) and *Stephanocoenia michelini*, and hermatypic, reef-building, corals (*Diploria strigosa*) are coral species found at Stetson Bank in scattered patches (DeBose et al., 2008). Recently, an invasive nudibranch, *Thecacrea pacifica*, has been reported at Stetson Bank (Hickerson et al., 2008). In addition to Stetson's unique landscape and topographic features (Figure 3-7 of the Multisale EIS), there is an abundance of marine life residing at the bank. Over 180 species of reef and schooling fishes and 644 species of invertebrates are documented (DeBose et al., 2008). Due to its vertical orientation (steep-sided crests within 23 m [75 ft] of the sea surface), Stetson Bank attracts a number of pelagic species that move back and forth across the continental shelf utilizing various banks, including the Flower Garden Banks, for seasonal feeding, mating, and as nursery grounds. These large pelagic animals include species such as manta and devil rays and the filter-feeding whale shark (DeBose et al., 2008; USDOC, NOAA, 2010e).

South Texas Banks

The South Texas Banks are geographically/geologically distinct from the shelf-edge banks. Several of the South Texas Banks are also low-relief banks. These banks exhibit a reduced biota and have relatively low relief, few hard-substrate outcrops, and a thicker sediment cover than the other banks (Rezak et al., 1983).

The South Texas Banks are generally inhabited by species typical of the Antipatharian Zone. Observations from Baker Bank (**Figure 4-4**), which had a similar benthic composition to other South Texas Banks, included black coral (*Cirrhipathes*), vase sponge (*Ircinia campana*), comatulid crinoids, sea fans, deepwater alcyonarians, small solitary corals, gorgonocephalan basket stars, American thorny oyster

(*Spondylus americanus*), brachiopods (*Argyrotheca barrettiana*), arrow crabs (*Stenorhynchus seticornis*), hermit crabs, black urchin (*Diadema antillarum*), sea cucumber (*Isostichopus*), and fireworms (*Hermodice*) (Rezak et al., 1983). Resident fish species included yellowtail reeffish, roughtongue bass, spotfin hogfish, reef butterflyfish, wrasse bass, tattler, gobies, and blue angelfish (Rezak et al., 1983). Migratory game and commercial fishes—red snapper, Vermilion snapper, greater amberjack, great barracuda, small carcharhinid sharks, and cobia—also inhabit the South Texas Banks (Rezak et al., 1983).

It has been suggested that three other South Texas features in the WPA be considered as sensitive offshore topographic features: Sebree, Big Adam, and Small Adam Banks. Sebree Bank (**Figure 4-4**), located in 36.5 m (120 ft) of water, is a low-relief feature of approximately 3 m (10 ft) in relief and is located in an area subject to high sedimentation. Clusters of the scleractinian coral, *Oculina diffusa*, have been observed on the rocky outcrops of this bank. This species tends to thrive in habitats exhibiting low light and high sedimentation. In the GOM, it forms branched, low-relief, generally round colonies, and does not create reefs or distinctive assemblages of reefal species. The most common fish associated with Sebree Bank were red snapper and tomtate grunt (Tunnell, 1981). Findings in the August 1993 cooperative dive effort on Sebree Bank by this Agency, the State of Texas, and Texas A&M University at Corpus Christi (Dokken et al., 1993) were generally consistent with those reported by Tunnell (1981). Dokken et al (1993) also reported sponges, hydroids, octocorals, and nonhermatypic corals present on the banks, although large areas of the reef were barren.

Dokken et al. (1993) compared the nepheloid-dominated, low-diversity community of Sebree Bank with the Nepheloid Zone community described by Rezak et al. (1985). Rezak and Bright (1981) devised an environmental priority index to rate the sensitivity of topographic features in the northern GOM.

- South Texas midshelf relict Pleistocene carbonate reefs bearing turbidity-tolerant Antipatharian Zone and Nepheloid Zone (surrounding depths of 60-80 m (197-262 ft), crests 56-70 m (184-230 ft)).
- North Texas-Louisiana midshelf, Tertiary-outcrop banks bearing clear-water, *Millepora*-Sponge Zone and turbid-water-tolerant Nepheloid Zone (surrounding depths of 50-62 m (164-203 ft), crests 18-40 m (59-131 ft).
- North Texas-Louisiana midshelf banks bearing turbidity-tolerant assemblages approximating the Antipatharian Zone (surrounding depths of 65-78 m (213-256 ft), crests 52-66 m (171-216 ft)).
- North Texas-Louisiana shelf-edge, carbonate banks bearing clear-water coral reefs and Algal-Sponge Zones, transitional assemblages approximating the Antipatharian Zone and Nepheloid Zone (surrounding depths of 84-200 m (276-656 ft), crests 15-75 m (49-246 ft)).
- Eastern Louisiana shelf-edge, carbonate banks bearing poorly developed elements of the Algal-Sponge Zone, transitional Antipatharian Zone assemblages, and Nepheloid Zone (surrounding depths of 100-110 m (328-361 ft), crests 67-73 m (220-240 ft).

Rezak and Bright (1981) categorized similar features containing Nepheloid Zone communities as banks where protection is not recommended. Since Sebree Bank (**Figure 4-4**) is located within a shipping fairway, it is relatively well protected from physical impacts (anchoring or drilling disturbance). While they did not specifically discuss Sebree Bank, based on five ranking criteria, similar Nepheloid Zone communities were given low ranking at other topographic features.

Big and Small Adam Banks are also low-relief features subject to sedimentation. Rezak and Bright (1981) categorized these features as banks where protection is not recommended. Although the banks may contain the Antipatharian Zone, this designation is speculative (Rezak et al., 1983). Big and Small Adam Banks were given the lowest ratings of those topographic features discussed by Rezak and Bright (1981), based on their criterion for environmental priority rankings.

Recent Invasive Species Concerns

Two invasive species have been reported in the Gulf of Mexico: the orange cup coral (*Tubastraea coccinea*) and the lionfish (*Pterois volitans/miles*). Invasive species are organisms that are not native to the local environment and have the potential to outcompete native species. *Tubastraea coccinea* was first reported in 2002 in the East Flower Garden Bank, but it is also reported to live on oil and gas platforms in the northern Gulf of Mexico, including one nearby the East Flower Garden Bank (Fenner and Banks, 2004; Sammarco et al., 2004; Hickerson et al., 2008). The lionfish has been reported off the coasts of Florida, Alabama, and Louisiana in 2010 (USDOI, GS, 2010b). Reports of this species began in 2006 in Florida, but the species was confirmed in the northern Gulf of Mexico in 2010 (Schofield, 2009; USDOI, GS, 2010b). It has also recently been reported in the southern Gulf of Mexico (Aguilar-Perera and Tuz-Sulub, 2010). Specific sitings were noted at Sonnier Bank and at several oil and gas platforms in the CPA (USDOI, GS, 2010b), and it is likely that this species will be found at banks and oil and gas platforms in the WPA as well.

Endangered Species

Elkhorn coral (*Acropora palmata*), which was listed as "threatened" in 2006 and is protected under the Endangered Species Act, is a common reef-building species in Caribbean coral reefs (USDOC, NOAA, 2010e). It was discovered at the West Flower Garden Bank in 2001 (Precht et al., 2006). Another colony of this species was discovered at the East Flower Garden Bank in 2005 (Precht et al., 2008). The northward expansion of this species is likely due to increasing water temperatures in the northern Gulf of Mexico (Precht and Aronson, 2004).

Candidate Species

In 2009, a petition was submitted to NOAA Fisheries by the Center for Biological Diversity to list 82 additional species of coral under the ESA (USDOC, NOAA, 2010e). Those 82 "candidate species" are currently under review by NOAA Fisheries. Some of the candidate species are found in the Gulf of Mexico, including *Montastraea annularis*, *Montastraea faveolata*, and *Montastraea franksi*. Once NOAA Fisheries has reviewed the candidate species, a decision will be made as to whether each species warrants listing under the ESA or not. If these species are listed, they will receive protection under the ESA.

Hurricane Impacts on WPA Banks

Severe hurricanes can cause physical damage to reef structure and organisms. On September 23, 2005, Hurricane Rita passed over the northwestern Gulf of Mexico, affecting at least 18 topographic features. The NOAA conducted surveys in October and November 2005 at the Flower Garden Banks and noted physical damage to coral and sponge communities on the Banks. Corals were broken and moved, sponges were destroyed, and sediment scouring and deposition was observed (Hickerson and Schmahl, 2007). Long-term monitoring studies of the East and West Flower Garden Banks have been conducted at select topographic features on a yearly basis through an equal partnership between BOEMRE and NOAA's National Marine Sanctuary Program. This monitoring includes studies since Hurricane Rita. An Agency-funded study, *Post-Hurricane Assessment of Sensitive Habitats of the Flower Garden Banks Vicinity* (Robbart et al., 2009), investigated hurricane effects at the East Flower Garden Bank. Initial assessment of the East Flower Garden Bank reveals mechanical damage from Hurricane Rita and a significant bleaching event (up to 46% of individual coral colonies). This was followed by an outbreak of coral disease affecting up to 8 percent of corals at the East Flower Garden Bank. These are the most severe recorded outbreaks of bleaching and disease at the Flower Garden Banks. Monitoring at the Flower Garden Banks in 2006 and 2007 showed recovery of corals with no significant deterioration of community health (Precht et al., 2006 and 2008; Robbart et al., 2009). Recovery of a *Madracis mirabilis* field and *Xestospongia muta* sponges were reported in August 2008, and their condition appeared healthy (Hickerson, 2008). The recovery observed after the hurricane and bleaching event agrees with reviews of long-term monitoring data of the Flower Garden Banks, indicating that this community is fairly resilient and stable over long periods of time (Gittings, 1998).

Stetson Bank was also studied pre- and post-Hurricanes Katrina and Rita in 2005. Stetson Bank experienced both physical damage as a result of the hurricanes and associated freshwater input from coastal runoff resulting from heavy rains associated with the hurricanes. It also suffered from a Caribbean-wide bleaching event that resulted from elevated water temperatures (DeBose et al., 2008). The predominant hydrozoan, *Millepora alcicornis* (fire coral), almost completely disappeared from the upper portion of the reef cap after 2005, but it had recovered to about half its former levels by 2008 (DeBose et al., 2008). Other hermatypic corals (*Diploria strigosa*, *Stephanocoenia intersepta*, *Madracis decactis*, *Madracis mirabilis*, and *Siderastrea radians*), however, have remained stable from 2004 to 2008 (DeBose et al., 2008). Another species, *Chondrilla nucula*, the chicken liver sponge, was also significantly reduced in 2005 and has not shown recovery. There does appear to be a trend in recovery at Stetson Bank, however, as an initial increase in macroalgae post-Hurricane Rita has decreased and was followed by an increase in coralline algae, which is often a predecessor to coral settlement (DeBose et al., 2008; Rezak et al., 1983).

Hurricane Ike passed over the East and West Flower Garden Banks on September 12, 2008. Similar destruction to the coral and sponge colonies was observed after Hurricane Ike as was observed after Hurricane Rita, except coral bleaching was not experienced with Hurricane Ike (Hickerson, 2008). Sponges were sheared, coral was broken and toppled, and heavy sediment scouring and deposition occurred. Damage was recorded in the same areas as occurred after Hurricane Rita, although it should be noted that substantial recovery had occurred by August 2008 at these sites (Hickerson, 2008). It is anticipated, based on the observed recovery of communities between 2005 and 2008, that similar recovery should occur following Hurricane Ike.

Baseline Conditions Following the *Deepwater Horizon* Event

The following sections contain all new data since the Multisale EIS and the 2009-2012 Supplemental EIS. Extensive literature, Internet, and database searches have been conducted for results of scientific data at topographic features following the DWH event. Although many research cruises have occurred, very few reports containing data have been released as of the preparation of this Supplemental EIS. Descriptions of studies in progress are discussed and any results indicated are included.

It is highly unlikely that the topographic features of the WPA have been impacted by the DWH event because of their distance from the oil spill. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). As a result of the distance of the topographic features from the location of the DWH event, it is anticipated that there will be no change in existing baseline conditions. The benthic communities on the topographic features are anticipated to remain a diverse and highly productive habitat that supports a variety of coral, sponge, algal, invertebrate, and fish species.

No visual observations of oil have been reported in or near the Flower Garden Banks National Marine Sanctuary as a result of the DWH event (Schmahl, official communication, 2011). Semipermeable membrane devices were deployed and sediment samples were collected at the East and West Flower Garden Banks and Stetson and Sonnier Banks between July 2010 and March 2011 to detect hydrocarbons in the water and sediment near these banks. The data were collected as part of the NRDA process, and analysis of the samples has not yet been released (Schmahl, official communication, 2011). The NOAA R/V *Thomas Jefferson* conducted a 13-day mission to collect baseline data in portions of the Gulf of Mexico. The cruise, which lasted from June 15-27, 2010, collected water samples to determine baseline conditions at the Flower Garden Banks National Marine Sanctuary prior to any possible impacts as a result of the oil spill as part of its mission (USDOC, NOAA, 2010g). Also, NOAA is currently monitoring for hydrocarbon substances using semipermeable membrane devices that have been placed on several banks in the Flower Garden Banks National Marine Sanctuary to determine if oil reaches any of the banks (USDOC, NOAA, 2010g). An early response "quick look" cruise conducted by NOAA and Harbor Branch Oceanographic Institute at the Flower Garden Banks from May 16-21, 2010, also did not report the presence of oil in the Sanctuary (Hickerson et al., 2010). As no observations of oil or oil-related impacts were discussed in the cruise report, it may be inferred that none were observed at the

Flower Garden Banks in May 2010 during the cruise. Based on the distance of the WPA from the Macondo well and the fact that the westernmost extent of the sheen from the DWH event remained east of the WPA, it is not expected that any information released from these cruises would impact BOEMRE's analysis of topographic features in the WPA or the potential impacts from the proposed action on these features. This information, therefore, is not essential to a reasoned choice among the alternatives analyzed in this Supplemental EIS.

4.1.1.6.2. Impacts of Routine Events

The vast majority of the Gulf of Mexico seabed is comprised of soft sediments. Topographic features formed on hard-bottom substrate are interspersed along the continental shelf above the soft sediment. These topographic features, which sustain sensitive offshore habitats in the WPA, are listed and described in **Chapter 4.1.1.6.1**.

The potential routine impact-producing factors on topographic features of the WPA are anchoring, infrastructure emplacement, drilling-effluent and produced-water discharges, and infrastructure removal. Impacts from accidental events such as oil spills and blowouts are discussed in **Chapter 4.1.1.6.3**. These disturbances have the potential to disrupt and alter the environmental, commercial, recreational, and aesthetic values of topographic features in the WPA.

A Topographic Features Stipulation similar to the one described in **Chapter 2.3.1.3.1** has been included in appropriate leases since 1973 and may, at the option of the ASLM, be made a part of appropriate leases resulting from this proposed action. The impact analysis of routine activities associated with the WPA proposed action presented here includes the proposed Topographic Features Stipulation. As noted in **Chapter 2.3.1.3.1**, the proposed stipulation establishes a No Activity Zone in which no bottom-disturbing activities would be allowed, and areas around the No Activity Zones (in most cases) within which shunting of drill cuttings and drilling fluids to near the bottom would be required.

Construction Impacts on Topographic Features

The anchoring of pipeline lay barges, drilling rigs, or service vessels, as well as the emplacement of structures (e.g., pipelines, drilling rigs, or production platforms), results in mechanical disturbances of the benthic environment. Anchor damage has been shown to be a large threat to the biota of the offshore banks in the Gulf (Rezak and Bright, 1979; Rezak et al., 1985; Gittings et al., 1992a; Hudson et al., 1982). Anchors may break, fragment, or overturn corals, sponges, and other benthic organisms; the anchor chain or cable may drag across and shear organisms off the substrate (Dinsdale and Harriott, 2004). Coral colonies may experience abrasion of tissue and skeletons, death to portions of a colony, fragmentation, or removal from substrate as a result of anchor damage (Dinsdale and Harriott, 2004). Branching species tend to experience fragmentation while massive species incur surface damage (Marshall, 2000). Anchor damage may result in community alteration through reduced coral cover, which indirectly promotes an increase in algal cover, complete coral removal, loss of sensitive species, reduction in colony size, and a reduction in soft coral cover in heavily damaged areas (Dinsdale and Harriott, 2004). Damage as a result of anchoring in a coral community may take 10 or more years from which to recover, depending on the extent of the damage (Fucik et al., 1984; Rogers and Garrison, 2001). Such anchoring damage, however, would be prevented within any given No Activity Zone by the observation of the proposed Topographic Features Stipulation, which does not allow bottom-disturbing activity.

Infrastructure emplacement and pipeline emplacement could result in suspended sediment plumes and sediment deposition on the seafloor. Considering the relatively elevated amounts of drilling muds and cuttings discharged per well (approximately 2,000 metric tons for exploratory wells [900 metric tons of drilling fluid and 1,100 metric tons of cuttings] and slightly lower discharges for development wells) (Neff, 2005), potential impacts on biological resources of topographic features should be expressly considered if drill sites occur in blocks directly adjacent to No Activity Zone boundaries. Potential impacts could be incurred through increased water-column turbidity, the smothering of sessile benthic invertebrates, and local accumulations of contaminants.

However, the proposed Topographic Features Stipulation requires all bottom-disturbing activity to be at least 152 m (500 ft) away from the boundaries of No Activity Zones. The proposed Topographic Features Stipulation limits impact through the No Activity Zone and shunting restrictions imposed within the 1-Mile Zone, 3-Mile Zone, 4-Mile Zone, and 1,000-Meter Zone. This would prevent well drilling activities from occurring in the No Activity Zone and preclude most resuspended sediments from reaching the biota of the banks. Also, USEPA's general NPDES permit sets special restrictions on discharge rates for muds and cuttings adjacent to topographic features bound by a No Activity Zone. Chapters 4.1.1.4.1 and 4.2.1.1.2.2 of the Multisale EIS detail the NPDES permit's general restrictions and the impacts of drilling muds and cuttings on marine water quality and seafloor sediments. Due to the proposed Topographic Features Stipulation and USEPA discharge regulations, turbidity and smothering impacts of sessile invertebrates on topographic features caused by drilling muds and cuttings are unlikely.

The proposed Topographic Features Stipulation would protect topographic features by physical distance from drilling activities. Drilling fluid plumes are rapidly dispersed on the OCS where approximately 90 percent of the material discharged in drilling a well (cuttings and drilling fluid) settles rapidly to the seafloor, while 10 percent forms a plume of fine mud that drifts in the water column (Neff, 2005). The composition of muds is strictly regulated, and discharges of cuttings/muds are tested to ensure that toxicity levels are below the limits allowed by NPDES permits (USEPA, 2004, 2007d, and 2009). Although drilling mud plumes may be visible 1 km (0.6 mi) from the discharge, rapid dilution of drilling mud plumes was reported within 6 m (20 ft) from the release point (Shinn et al., 1980; Hudson et al., 1982). Drilling muds and cuttings may be diluted 100 times at 10 m (33 ft) from the discharge and 1,000 times at 100 m (328 ft) from the discharge (Neff, 2005). Dilution continues with distance from the discharge point; at 96 m (315 ft) from the release point, Shinn et al. (1980) measured a plume as only a few milligrams/liter above background suspended sediment concentrations. Suspended sediment concentrations at 6 m (20 ft) from the discharge were often less than those produced during storms or from boat wakes (Shinn et al., 1980).

It is not anticipated that muds drifting in the water column would settle on topographic features. The mud particles are extremely fine and would not be able to settle in the high-energy environments surrounding topographic features (Shinn et al., 1980; Hudson and Robin, 1980). Any mud that may reach coral can be removed by the coral using tentacles and mucus secretion, and physically removed by currents that can shed the mucus-trapped particles from the coral (Shinn et al., 1980; Hudson and Robin, 1980). Considering that drilling is not allowed within 152 m (500 ft) of a No Activity Zone, that shunting to within 10 m (33 ft) of the bottom is required surrounding the No Activity Zone, and that field measurements indicate suspended solids 96 m (315 ft) from the discharge point are far below concentrations that cause coral mortality (Shinn et al., 1980), corals should be adequately distanced for protection from the effects of drilling turbidity.

Due to the proposed Topographic Features Stipulation, impacts measured as a result of drilling operations would be minimal in comparison to impacts without the proposed Topographic Features Stipulation. Wells drilled in lease blocks containing topographic features would be required to shunt cuttings to within 10 m (33 ft) of the seafloor. Bottom shunting would protect the organisms on the topographic features because it results in localized deposition of cuttings at a greater depth than the biological activity of the topographic features (Neff, 2005). Therefore, the deposited material is not anticipated to reach the benthic organisms on the reef.

Long-Term and Operational Impacts on Topographic Features

Both distance from drilling operations and shunting of cuttings to the seafloor are anticipated to reduce exposure pathways of drilling activities to benthic organisms on topographic features, eliminating long-term operational impacts, such as exposure to turbidity and sedimentation or associated contaminants.

Produced waters are discharged at the water surface throughout the lifetime of the production platform and may contain hydrocarbons, trace metals, elemental sulfur, and radionuclides (Kendall and Rainey, 1991). Heavy metals enriched in the produced waters include cadmium, lead, iron, and barium (Trefry et al., 1995). Produced waters may impact both organisms attached to the production platform and benthic organisms in the sediment beneath the platform. A detailed description of the impacts of produced waters on water quality and seafloor sediments is presented in Chapter 4.2.1.1.2 of the Multisale EIS.

Produced waters are rapidly diluted and impacts are generally only observed within close proximity of the discharge point (Gittings et al., 1992a). Past evaluation of the bioaccumulation of offshore, produced-water discharges conducted by the Offshore Operators Committee (Ray, 1998) assessed that metals discharged in produced water would, at worst, affect living organisms found in the immediate vicinity of the discharge, particularly those attached to the submerged portion of platforms. Possibly toxic concentrations of produced water were reported 20 m (66 ft) from the discharge in both the sediment and the water column where elevated levels of hydrocarbons, lead, and barium occurred, but no impacts to marine organisms or sediment contamination were reported beyond 100 m (328 ft) of the discharge (Neff and Sauer, 1991; Trefry et al., 1995). A study conducted on two species of mollusk and five species of fish (Ray, 1998) found that naturally occurring radioactive material in produced water was not found to bioaccumulate in marine animals. Because high-molecular PAH's are usually in such dilute concentrations in produced water, they pose little threat to marine organisms and their constituents, and they were not anticipated to biomagnify in marine food webs. Monocyclic hydrocarbons and other miscellaneous organic chemicals are known to be moderately toxic, but they do not bioaccumulate to high concentrations in marine organisms and are not known to pose a risk to their consumers (Ray, 1998).

Produced waters should not affect the biota of topographic features. The greatest impacts are reported adjacent to the discharge and substantially reduced less than 100 m (328 ft) from the discharge, which is less than the 152-m (500-ft) buffer around the No Activity Zone that surrounds topographic features. Also, USEPA's general NPDES permit restrictions on the discharge of produced water would help to limit the impacts on biological resources of topographic features.

Structure-Removal Impacts

The impacts of structure removal on soft-bottom benthic communities can include turbidity, sediment deposition, explosive shock-wave impacts, and loss of habitat. Both explosive and nonexplosive removal operations would disturb the seafloor by generating considerable turbidity. Suspended sediment may evoke physiological impacts in benthic organisms, including changes in respiration rate, abrasion and puncturing of structures, reduced feeding, reduced water filtration rates, smothering, delayed or reduced hatching of eggs, reduced larval growth or development, abnormal larval development, or reduced response to physical stimulus (Anchor Environmental CA, L.P., 2003). Light may also be blocked, resulting in reduced photosynthesis (Rogers, 1990). Long-term exposures to turbidity have even resulted in significantly reduced skeletal extension rates in the scleractinian coral *Montastraea annularis* (Torres, 2001). The higher the concentration of suspended sediment in the water column and the longer the sediment remains suspended, the greater the impact.

Sediment deposition may smother benthic organisms, decreasing gas exchange, increasing exposure to anaerobic sediment, reducing light intensity, and causing physical abrasion (Wilber et al., 2005). Corals have some ability to rid themselves of sediment through mucus production and ciliary action (Marszalek, 1981; Bak and Elgershuizen, 1976; Telesnicki and Goldberg, 1995). Scleractinian corals are tolerant of short-term sediment exposure and burial, but longer exposures may result in loss of zooxanthellae, polyp swelling, lesions, increased mucus production, alterations in growth rates and forms, decreased calcification, decreased photosynthesis, increased respiration, reduced areal coverage, changes in species diversity and dominance patterns, reduced recruitment, reduced reef development, and mortality (Marszalek, 1981; Rice and Hunter, 1992; Torres et al., 2001; Telesnicki and Goldberg, 1995). Coral larvae settlement may be inhibited in areas where sediment has covered available substrate (Rogers, 1990; Goh and Lee, 2008). Bleached tissue as a result of sediment exposure has been reported to recover in approximately a month (Wesseling et al., 1999).

Octocorals and gorgonians are more tolerant of sediment deposition than scleractinian corals, as they grow erect and are flexible, reducing sediment accumulation and allowing easy removal (Marszalek, 1981; Torres et al., 2001; Gittings et al., 1992b). Branching forms of scleractinian corals also tend to be more tolerant of sediment deposition than massive and encrusting forms (Roy and Smith, 1971). Some of the more sediment-tolerant massive forms of scleractinian species in the Gulf of Mexico include *Montastraea cavernosa*, *Siderastrea siderea*, *Siderastrea radians*, and *Diploria strigosa* (Torres et al., 2001; Acevedo et al., 1989; Loya, 1976a).

The shock waves produced by explosive structure removals may also harm benthic biota. However, corals and other sessile invertebrates have a high resistance to shock. O'Keeffe and Young (1984) described the impacts of underwater explosions on various forms of sea life using, for the most part, open-water explosions much larger than those used in typical structure-removal operations. They found that sessile benthic organisms, such as barnacles and oysters, and many motile forms of life, such as shrimp and crabs that do not possess swim bladders, were remarkably resistant to shock waves generated by underwater explosions. Oysters located 8 m (26 ft) away from the detonation of 135-kilogram (kg) (298-pound [lb]) charges in open water incurred a 5-percent mortality rate. Crabs distanced 8 m (26 ft) away from the explosion of 14-kg (31-lb) charges in open water had a 90-percent mortality rate. Few crabs died when the charges were detonated 46 m (151 ft) away. O'Keeffe and Young (1984) also described lack of damage to other invertebrates such as sea anemones, polychaete worms, isopods, and amphipods.

Charges used in OCS structure removals are typically much smaller than some of those cited by O'Keeffe and Young. The *Programmatic Environmental Assessment for Structural Removal Activities* (USDOI, MMS, 2005) predicts low impacts on the sensitive offshore habitats from platform removal precisely because of the effectiveness of the proposed stipulation in preventing platform emplacement in the most sensitive areas of the topographic features of the GOM. Impacts on the biotic communities, other than those on or directly associated with the platform, would be limited by the relatively small size of individual charges (normally ≤50 lb [27 kg] per well piling and per conductor jacket) and because BOEMRE regulations require charges to be detonated 5 m (15 ft) below the mudline and at least 0.9 seconds apart (to prevent shock waves from becoming additive) (USDOI, MMS, 2005). Also, because the proposed Topographic Features Stipulation precludes platform installation within 152 m (500 ft) of a No Activity Zone, adverse effects to topographic features by removal explosives should be prevented. The shock wave is significantly attenuated when explosives are buried, as opposed to detonation in the water column (Baxter et al., 1982; Wright and Hopky, 1998).

Removal of infrastructure would result in the removal of the hard substrate and encrusting community, with overall reduction in species diversity (both epifaunal encrusting organisms and the fish and large invertebrates that fed on them) with the removal of the structure (Schroeder and Love, 2004). The epifaunal organisms attached to the platform would die once the platform is removed. However, the seafloor habitat would return to the original soft-bottom substrate that existed before the well was drilled.

Some structures may be converted to artificial reefs. If the rig stays in place, the hard substrate and encrusting communities would remain part of the benthic habitat. The diversity of the community would not change, and associated finfish species would continue to graze on the encrusting organisms. The community would remain an active artificial reef. However, the plugging of wells and other reef-in-place decommissioning activities would still impact benthic communities as discussed above, since all the steps for removal, except final removal, from the water would still occur.

Proposed Action Analysis

All of the 22 topographic features (shelf edge banks, low-relief banks, and south Texas banks) in the WPA are found in waters less than 200 m (656 ft) deep. They represent a small fraction of the WPA. As noted above, the proposed Topographic Features Stipulation could prevent most of the potential impacts from oil and gas operations on the biota of topographic features, including direct contact during pipeline, rig, and platform emplacements; anchoring activities; and removals. Yet, operations outside the No Activity Zone could still affect topographic features through drilling discharges, produced-water discharges, blowouts, and oil spills. Potential impacts from oil spills and blowouts are discussed in **Chapter 4.1.1.6.3**.

For the WPA proposed action, 21-36 exploration/delineation and 58-89 development wells are projected for offshore Subareas W0-60. There are an additional 5-7 exploration/delineation wells and 11-15 development wells proposed between 60 and 200 m (197 and 656 ft) (out to the boundary of the continental shelf) (**Table 3-2**). With the inclusion of the proposed Topographic Features Stipulation, no discharges would take place within the No Activity Zone. Most drilling discharges would be shunted to within 10 m (33 ft) of the seafloor either within the 1,000-Meter Zone, 1-Mile Zone, 3-Mile Zone, or 4-Mile Zone (depending on the topographic feature) around the No Activity Zone (see **Chapter 2.3.1.3.1** for specifics). This procedure would essentially prevent the threat of drilling effluents reaching the biota of a topographic feature (Bright and Rezak, 1978). Also, most studies indicate that biological impacts and sediment contamination occur within 100 m (328 ft) of production platforms (Montagna and Harper, 1996; Kennicutt at al., 1996; Neff and Sauer, 1991; Trefry et al., 1995). If drilling discharges or produced waters do reach any topographic features, concentrations of these anthropogenic influences would be diluted substantially from their initial concentration, and effects would be minimal.

For the WPA proposed action, 19-31 production structures are projected in offshore Subareas W0-60 and 2 production structures are predicted for Subareas W60-200. From 9 to 17 structure removals using explosives are projected for the Subareas W0-60 and one is projected in Subareas W60-200 (**Table 3-2**). The explosive removal of platforms should not impact the biota of topographic features because the proposed Topographic Features Stipulation prohibits the emplacement of platforms within 152 m (500 ft) of the No Activity Zone boundaries. This emplacement would prevent shock-wave impacts and resuspended sediments from reaching the biota of topographic features. Site clearance operations following a structure removal typically employ trawling the sea bottom within a radius of up to 400 m (1,320 ft) to retrieve anthropogenic debris. In areas near sensitive habitats, operators may be required to use sonar to detect debris and scuba divers to retrieve it. This precaution is exercised by BOEMRE as needed in the activity permitting process.

Summary and Conclusion

The proposed Topographic Features Stipulation, if applied, would prevent most of the potential impacts on topographic features from bottom-disturbing activities (structure removal and emplacement) and operational discharges associated with the WPA proposed action through avoidance, by requiring individual activities to be located at specified distances from the feature or zone. Because of the No Activity Zone, permit restrictions, and the high-energy environment associated with topographic features, if any contaminants reach topographic features, they would be diluted from their original concentration, and impacts that do occur would be minimal.

Effects of the Proposed Action without the Proposed Stipulation

The topographic features and associated coral reef biota of the WPA could be adversely impacted by oil and gas activities resulting from the proposed action in the absence of the proposed Topographic Features Stipulation. This would be particularly true should operations occur directly on top of or in the immediate vicinity of otherwise protected WPA topographic features.

The No Activity Zone of the topographic features would be most susceptible to adverse impacts if oil and gas activities are unrestricted without the proposed Topographic Feature Stipulation and not followed up by mitigating measures. These impacting activities could include vessel anchoring and infrastructure emplacement; discharges of drilling muds, cuttings, and produced water; and ultimately the explosive removal of structures. All of the above-listed activities have the potential to considerably alter the diversity, cover, and long-term viability of the reef biota found within the No Activity Zone. In most cases, recovery from disturbances would take 10 years or more (Fucik et al., 1984; Rogers and Garrison, 2001). Long-lasting and possibly irreversible change would be caused mainly by vessel anchoring and structure emplacement (pipelines, drill rigs, and platforms). Such activities would physically and mechanically alter benthic substrates and their associated biota. Operational discharges would cause substantial and prolonged turbidity and sedimentation, possibly impeding the well-being and permanence of the biota and interfering with larval settlement, resulting in the decrease of live benthic cover. Finally, the unrestricted use of explosives to remove platforms installed in the vicinity of or on the topographic features could cause turbidity, sedimentation, and shock-wave impacts that would affect reef biota.

The shunting of cuttings and fluids, which would be required by the Topographic Features Stipulation, is intended to limit the smothering and crushing of sensitive benthic organisms caused by depositing foreign substances onto the topographic features. The impacts from unshunted exploration and development discharges of drill cuttings and drilling fluids within the 1,000-Meter Zone, 1-Mile Zone, and 4-Mile Zone would definitely impact the biota of topographic features. Specifically, the discharged materials would cause prolonged events of turbidity and sedimentation, which could have long-term deleterious effects on local primary production, predation, and consumption by benthic and pelagic organisms, biological diversity, and benthic live cover. The unrestricted discharge of operational effluents would be a further source of impact to the sensitive biological resources of the topographic features. Therefore, in the absence of the proposed Topographic Features Stipulation, the proposed action could cause long-term (10 years or more) adverse impacts to the biota of the topographic features (Fucik et al., 1984; Rogers and Garrison, 2001).

4.1.1.6.3. Impacts of Accidental Events

The topographic features of the WPA that sustain sensitive offshore habitats are listed and described in **Chapter 4.1.1.6.1**. See **Chapter 2.3.1.3.1** for a complete description and discussion of the proposed Topographic Features Stipulation.

Disturbances resulting from the WPA proposed action, including oil spills and blowouts, have the potential to disrupt and alter the environmental, commercial, recreational, and aesthetic values of topographic features of the WPA.

A search was conducted for additional new information published since completion of the Multisale EIS and the 2009-2012 Supplemental EIS. Various Internet sources and journal articles were examined to discover any recent information regarding impacts of oil on benthic organisms. Sources investigated include literature published in journals and websites (NOAA, USEPA, and coastal universities). The following information is a summary of the accidental impacts incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Possible Modes of Exposure

Oil released to the environment as a result of an accidental event may impact topographic features in several ways. Oil may be physically mixed into the water column from the sea surface, be injected below the sea surface and travel with currents, be dispersed in the water column, or be adsorbed to sediment particles and sink to the seafloor. These scenarios and their possible impacts are discussed in the following sections.

An oil spill that occurs at the sea surface would result in a majority of the oil remaining at the sea surface. Lighter compounds in the oil may evaporate, and some components of the oil may dissolve in the seawater. Evaporation allows the removal of the most toxic components of the oil, while dissolution may allow bioavailability of hydrocarbons to marine organisms for a brief period of time (Lewis and Aurand, 1997). Remnants of the oil may then emulsify with water or sediment to particles and fall to the seafloor.

A spill that occurs below the sea surface (i.e., at the rig, along the riser between the seafloor and sea surface, or through leak paths on the BOP/wellhead) would result in most of the released oil rising to the sea surface. All known reserves in the Gulf of Mexico have specific gravity characteristics that would preclude oil from sinking immediately after release at a blowout site. As discussed in Chapter 4.3.1.5.4 of the Multisale EIS, oil discharges that occur at the seafloor from a pipeline or loss of well control would rise in the water column, surfacing almost directly over the source location, thus not impacting sensitive deepwater communities. If the leak is deep in the water column and the oil is ejected under pressure, oil droplets may become entrained deep in the water column (Boehm and Fiest, 1982). The upward movement of the oil may be reduced if methane in the oil is dissolved at the high underwater pressures, reducing the oil's buoyancy (Adcroft et al., 2010). The large oil droplets would rise to the sea surface, but the smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010). Oil droplets less than 100 μm in diameter may remain in the water column for several months (Joint Analysis Group, 2010a). Dispersed oil in the water column begins to biodegrade and may flocculate with particulate matter, promoting sinking of the particles.

Impacts that may occur to benthic communities on topographic features as a result of a spill would depend on the type of spill, distance from the spill, relief of the biological feature, and surrounding physical characteristics of the environment (e.g., turbidity). The NTL 2009-G39 describes the proposed Topographic Features Stipulation, which requires buffers to prevent oil spills in the immediate vicinity of a topographic feature or its associated biota. The BOEMRE has created No Activity Zones around topographic features in order to protect these habitats from disruption due to oil and gas activities. A No Activity Zone is a protective perimeter drawn around each feature that is associated with a specific isobath (depth contour) surrounding the feature in which structures, drilling rigs, pipelines, and anchoring are not allowed. These No Activity Zones are areas protected by BOEMRE policy. The NTL 2009-G39 recommends that drilling not occur within 152 m (500 ft) of a No Activity Zone of a topographic feature. This additional recommendation is based on essential fish habitat, and construction within the essential fish habitat would require project-specific consultation with NOAA.

Oil released during accidental events may reach topographic features. As described above, most of the oil released from a spill would rise to the sea surface and therefore reduce the amount of oil that may directly contact benthic communities. Small droplets of oil in the water column could possibly migrate into No Activity Zones, attach to suspended particles in the water column, and sink to the seafloor (McAuliffe et al., 1975). Topographic features and their benthic communities that are exposed to subsea plumes, dispersed oil, or oil adsorbed to sediment particles may demonstrate reduced recruitment success, reduced growth, and reduced coral cover as a result of impaired recruitment. These impacts are discussed in the following sections.

Surface Slicks and Physical Mixing

The potential of a surface oil slick to affect topographic features is limited by its ability to mix into the water column. Topographic features are high-relief protrusions above the seafloor on the continental shelf; the shallowest peaks rise to within 15 m (49 ft) of the sea surface. The two peaks of the Flower Garden Banks are the shallowest and most sensitive features, supporting true coral reefs. Other banks are deeper, supporting reef communities but not coral reefs (**Chapter 4.1.1.6.1**). The depth of the topographic features below the sea surface helps protect benthic species from physical oil contact through distance below the sea surface.

Field data collected at the Atlantic entrance to the Panama Canal 2 months after a tanker spill has shown that subtidal coral species (i.e., *Porites furcata*, *Porites asteroids*, *Siderastraea radians*, and *Millepora complanata*), all of which are also present in the Gulf of Mexico, did not show measurable impacts from the oil spill, presumably because the coral was far enough below the surface oil and the oil did not contact the coral (Rützler and Sterrer, 1970). Similar results were reported from a Florida coral reef immediately following and 6 months after a tanker discharged oil nearby (Chan, 1977). The lack of acute toxicity was again attributed to the fact that the corals were completely submerged at the time of the spill and calm conditions prevented the oil from mixing into the water column (Chan, 1977).

Disturbance of the sea surface by storms can mix surface oil into the water column, but the effects are generally limited to the upper 10 m (33 ft). Modeling exercises have indicated that oil may reach a depth of 20 m (66 ft). Yet at this depth, the spilled oil would be at concentrations several orders of magnitude lower than the amount shown to have an effect on marine organisms (Lange, 1985; McAuliffe et al., 1975 and 1981a; Tkalich and Chan, 2002). Therefore, depth may contribute to the protection of topographic features from physical mixing of surface oil below the sea surface. However, if dispersants are used, they would enable oil to mix into the water column and possibly impact organisms on the topographic features. Dispersants are discussed later in this section.

Subsurface Plumes

A subsurface oil spill or plume has the potential to reach a topographic feature and cause negative effects. Such impacts on the biota may have severe and long-lasting consequences, including loss of habitat, biodiversity, and live coverage; change in community structure; and failed reproductive success.

Topographic features are sheltered from petroleum-producing activities through the distance provided from No Activity Zone and the NTL 2009-G39 recommendation of the additional 152-m (500-ft) buffer beyond the No Activity Zone. The distance allows for several physical and biological changes to occur to the oil before it reaches sensitive benthic organisms. Oil would become diluted as it physically mixes with the surrounding water, and some evaporation may occur. The longer and farther a subsea plume travels in the sea, the more dilute the oil will be (Vandermeulen, 1982; Tkalich and Chan, 2002). Microbial degradation of the oil occurs in the water column, reducing toxicity (Hazen et al., 2010; McAuliffe et al., 1981b). In addition, oil can adsorb to sediments in the water column and sink to the seafloor. The oil will move in the direction of prevailing currents (S.L. Ross Environmental Research Ltd., 1997); however, the banks would be physically protected because currents move around the topographic features, which may help sweep the subsea oil clear of the banks (Rezak et al., 1978 and 1983; McGrail, 1982). Also, subsea oil plumes transported by currents may not travel nearly as far as surface oil slicks because some oil droplets may conglomerate and rise or may be blocked by fronts, as was observed in the southern Gulf of Mexico during the *Ixtoc I* spill (Boehm and Fiest, 1982). Should any of the oil come in contact with adult sessile biota, effects would be primarily sublethal, as the oil would be diluted by physical and biological processes by the time it reaches the banks. Low-level exposure impacts may vary from chronic to temporary, or even immeasurable.

In the event that low concentrations of oil transported in subsea plumes reach benthic features, coral feeding activity may be reduced. Experiments indicated that normal feeding activity of *Porites porites* and *Madracis asperula* were reduced when exposed to 50 ppm oil (Lewis, 1971). Tentacle pulsation of an octocoral, *Heteroxenia fuscescens*, has also been shown to decrease upon oil exposure, although recovery of normal pulsation was observed 96 hours after the coral was removed from the oil (Cohen et al., 1977). *Porites furcata* exposed to marine diesel and Bunker C oil reduced feeding and left their mouths open for longer than normal periods of time (Reimer, 1975).

Direct oil contact may result in coral tissue damage. Coral exposed to sublethal concentrations of oil for 3 months revealed atrophy of muscle bundles and mucus cells (Peters et al., 1981). *Porites furcata* submersed in Bunker C oil for 1 minute resulted in 100 percent tissue death (with a lag time of 114 days) (Reimer, 1975).

Reproductive ability may also be reduced if coral is exposed to oil. A hermatypic coral, *Stylophora pistillata*, and an octocoral, *Heteroxenia fuscescens*, shed their larvae when exposed to oil (Loya and Rinkevich, 1979; Rinkevich and Loya, 1977; Cohen et al., 1977). Neither of these species is present in the Gulf of Mexico, but impacts may be similar in Gulf species. Undeveloped larvae exposed to oil in the water column have a reduced chance of survival due to predation (Loya and Rinkevich, 1979), which would in turn reduce the ability of larval settlement and reef expansion or recovery. A similar expulsion of gametes may occur in species that have external fertilization (Loya and Rinkevich, 1979), such as those at the Flower Garden Banks (Gittings et al., 1992c), which may then reduce gamete survivorship due to oil exposure.

The overall ability of a coral colony to reproduce may be affected by oil exposure. Reefs of *Siderastrea siderea* that were oiled in a spill produced smaller gonads than unoiled reefs, which resulted in reproductive stress for the oiled reef (Guzmán and Holst, 1993). *Stylophora pistillata* reefs exposed to oil had fewer breeding colonies, reduced number of ovaria per polyp, and significantly reduced fecundity compared with unoiled reefs (Rinkevich and Loya, 1977). Impaired development of reproductive tissue has been reported for other reef-building corals exposed to sublethal concentrations of oil as well (Peters et al., 1981). Larvae also may not be able to settle on reefs impacted by oil. Field experiments on *Stylophora pistillata* showed reduced settlement rates of larvae on artificial substrates of oiled reefs compared with control reefs and lower settlement rates with increasing concentrations of oil in test containers (Rinkevich and Loya, 1977).

Oil exposure is believed to reduce photosynthesis and growth in corals; however, low-level exposures have produced counterintuitive and sometimes immeasurable results. Photosynthesis of the zooxanthellae in *Diplora strigosa* exposed to approximately 18-20 ppm crude oil for 8 hours was not measurably affected, although other experiments indicate that photosynthesis may be impaired at higher concentrations (Cook and Knap, 1983). A longer exposure (24 hours) of 20 mL/L (20 ppt) oil markedly reduced photosynthesis in *Stylophora pistillata*; however, concentrations of 2.5 mL/L (2.5 ppt) oil resulted in physiological stress that caused a measurable increase in photosynthesis as compared with controls (Rinkevich and Loya, 1983). Other impacts recorded include the degeneration and expulsion of photosynthetic zooxanthellae upon coral exposure to oil (Loya and Rinkevich, 1979; Peters et al., 1981). Long-term growth changes in *Diploria strigosa* that was exposed to oil concentrations up to 50 ppm for 6-24 hours did not show any measurably reduced growth in the following year (Dodge et al., 1984).

Corals exposed to subsea oil plumes may also incorporate petroleum hydrocarbons into their tissue. Records indicate that *Siderastrea siderea*, *Diploria strigosa*, *Montastrea annularis*, and *Heteroxenia fuscescens* have accumulated oil from the water column and have incorporated petroleum hydrocarbons into their tissues (Burns and Knap, 1989; Knap et al., 1982; Kennedy et al., 1992; Cohen et al., 1977). Hydrocarbon uptake may also modify lipid ratios of coral (Burns and Knap, 1989). If lipid ratios are modified, mucus synthesis may be impacted, adversely affecting coral ability to protect itself from oil through mucus production (Burns and Knap, 1989).

Sublethal effects, although often hard to measure, could be long lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature, extreme low tides, and diseases) (Jackson et al., 1989; Loya, 1976b). Continued exposure to oil from resuspended contaminated sediments in the area could also impact coral growth and recovery (Guzmán et al., 1994). Any repetitive or long-term oil exposure could inhibit coral larvae's ability to settle and grow, may damage coral reproductive systems, may cause acute toxicity to larvae, and may physically alter the reef interfering with larval settlement, all of which would reduce coral recruitment to an impacted area (Kushmaro et al., 1997; Loya, 1975 and 1976b; Rinkevich and Loya, 1977). Exposure of eggs and larvae to oil in the water column may reduce the success of a spawning event (Peters et al., 1997). Sublethal exposure to oil may, in fact, be more detrimental to corals than high concentrations of oil (Cohen et al., 1977), as sublethal concentrations are typically more widespread and have a larger overall community effect. Therefore, the sublethal effects of oil exposure, even at low concentrations, may have long-lasting effects on the community.

There was, however, a recent report that indicated damage to a deepwater coral community in the CPA (11 km [7 mi] from the Macondo well) in water far deeper than the reef organisms on topographic features. This deepwater coral community appears to have been impacted by contact with oil from the DWH event (USDOI, BOEMRE, 2010j). The circumstances of the deepwater coral exposure were not typical because the release of oil was 1,500 m (5,000 ft) below the sea surface at high pressure, which caused the formation of a subsea plume of oil that was treated with dispersant (Joint Analysis Group, 2010a). This 200-m (656-ft) thick subsea plume was in deep water (1,100 to 1,300 m [3,600 to 4,265 ft]) thought to be bounded by stratified density layers of water, allowing it to remain at depth instead of dispersing into the water column, and it eventually contacted the coral. This situation identified with this deepwater coral community in the CPA would not be expected to occur on the continental shelf where the topographic features are located. Stratified waters (nepheloid layer) found on the continental shelf are normally restricted to near the seafloor no more than 20 m (66 ft) up into the water column (Bright et al., 1976; Bright and Rezak, 1978). So, while stratified layers in deep water may cover 200 m (656 ft) of depth, layers on the shelf would have a smaller range, and oil trapped in the bottom layer would be restricted to less than 20 m (66 ft) above the seafloor. The reef organisms of the topographic features live above the turbid waters, and therefore, could not be contacted by a stratified oil later. Also, currents typically travel around, not over, topographic features, directing oil away from topographic highs rather than over them (Rezak et al., 1983).

In addition, the lease stipulations described in NTL 2009-G39 protect topographic features from both routine and accidental impacts that may occur during petroleum production. These stipulations, among other things, focus OCS activities at specified distances from the topographic features, thereby increasing the distance between the topographic features and the potential accidental event. In the case of a spill, this distance would reduce the potential for contact with the features, as the released oil would be expected to rise to the surface and disperse in the water.

Dispersed Oil

Chemically dispersed oil from a surface slick is not anticipated to result in lethal exposures to organisms on topographic features. The chemical dispersion of oil may increase the weathering process and allow surface oil to penetrate to greater depths than physical mixing would permit, and the dispersed oil generally remains below the water's surface (McAuliffe et al., 1981b; Lewis and Aurand, 1997). However, reports on dispersant usage on surface plumes indicate that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a). Dispersant usage also reduces the oil's ability to stick to particles in the water column, minimizing oil adsorbed to sediment particles traveling to the seafloor (McAuliffe et al., 1981a; Lewis and Aurand, 1997).

Field experiments designed to test dispersant use on oil spills reported dispersed oil concentrations between 1 and 3 ppm, 9 m (26 ft) below the sea surface, approximately 1 hour after treatment with dispersant (McAuliffe et al., 1981a and 1981b). Other studies indicated that dispersed oil concentrations were <1 ppm, 10 m (33 ft) below the sea surface (Lewis and Aurand, 1997). The above data indicate that the mixing depth of dispersed oil is less than the depths of the crests of topographic features (greater than 15 m [49 ft] below the sea surface), greatly reducing the possibility of exposure to dispersed surface oil.

Any dispersed surface oil that may reach the benthic communities of topographic features in the Gulf of Mexico would be expected to be at very low concentrations (<1 ppm) (McAuliffe et al., 1981a). Such concentrations would not be life threatening to larval or adult stages based on experiments conducted with coral (Lewis, 1971; Elgershuizen and De Kruijf, 1976; Knap, 1987; Wyers et al., 1986; Cohen et al., 1977) and observations after oil spills (Jackson et al., 1989; Guzmán et al., 1991). Any dispersed oil in the water column that comes in contact with corals, however, may evoke short-term negative responses by the organisms, such as reduced feeding and photosynthesis or altered behavior (Wyers et al., 1986; Cook and Knap, 1983; Dodge et al., 1984).

The use of dispersants near or above protected features, such as the Flower Garden Banks, is not recommended because dispersants allow floating oil to mix with water. The Flower Garden Banks National Marine Sanctuary helped to develop a regional response plan for dispersant use near the sanctuary, using literature, field observations, and spill risk assessments (Gittings, 2006). Results of the investigations led to a NOAA Policy revision in 1994 that allowed dispersant use if the Federal On-Scene Coordinator deems it appropriate; however, the Flower Garden Banks National Marine Sanctuary requests that dispersant application be as far as possible from the Sanctuary and not occur during seasonal species gatherings or spawning. Also, the Sanctuary's management must be consulted and forwarded incident relevant data (Gittings, 2006). The distancing of the dispersant application from the Flower Garden Banks National Marine Sanctuary would allow for dilution of the compounds in the surrounding water column away from protected habitat.

Dispersants that are used on oil below the sea surface can travel with currents through the water and may contact benthic organisms on the topographic features. If the oil spill occurs near a topographic feature, the dispersed oil could be concentrated enough to harm the community. However, the longer the oil remains suspended in the water column traveling with currents, the more dispersed it would become. Weathering would also be accelerated and biological toxicity reduced (McAuliffe et al., 1981b). Although the use of subsea dispersants is a new technique and very little data are available on dispersion rates, it is anticipated that any oil that could reach topographic features would be in low concentration based on surface slick dilution data (McAuliffe et al., 1981a; Lewis and Aurand, 1997). Currents around the topographic features may sweep the subsea oil clear of the features, as bottom currents typically travel around topographic highs rather than over them (Rezak et al., 1983). Recent data from studies of the DWH event and resulting spill showed that oil treated with dispersant at depth remained at a water depth between 1,100 and 1,300 m (3,600 and 4,265 ft) (Joint Analysis Group, 2010a). This subsea plume was in deep water rather than on the continental shelf. While the DWH event's subsea oil plume ranged through a 200-m (656-ft) depth range, it was thought to be bounded by stratified density layers of water. Stratification is also found on the continental shelf. Studies of the nepheloid layer (a layer of turbid water) showed that stratified water normally restricts the nepheloid layer to near the seafloor, no more than 20 m (66 ft) up into the water column (Bright et al., 1976; Bright and Rezak, 1978). So, while stratified layers in deep water may cover 200 m (656 ft) of depth, layers on the shelf have a smaller range and oil trapped in the bottom layer may be restricted to less than 20 m (66 ft) above the seafloor. Unusual circumstances, such as mixing resulting from passage of a hurricane, may change this situation somewhat, causing subsea oil plumes to mix through the entire water column. However, such mixing would also serve to reduce the concentration of toxic components. Therefore, impacts resulting from exposure to dispersed oil are anticipated to be sublethal for communities on topographic features. In some cases, less diverse communities at the base of topographic features could experience lethal contact with subsea oil plumes if the source of the spill is nearby on the seafloor.

Sublethal impacts that may occur to coral exposed to dispersed oil may include reduced feeding and photosynthesis, reduced reproduction and growth, physical tissue damage, and altered behavior. Short-term, sublethal responses of *Diploria strigosa* were reported after exposure to dispersed oil at a concentration of 20 ppm for 24 hours (Knap et al., 1983; Wyers et al., 1986). Although concentrations in this experiment were higher than what is anticipated for dispersed oil at depth, effects included mesenterial filament extrusion, extreme tissue contraction, tentacle retraction, localized tissue rupture (Wyers et al., 1986), and a decline in tentacle expansion behavior (Knap et al., 1983). Normal behavior resumed within 2 hours to 7 days after exposure (Wyers et al., 1986; Knap et al., 1983). This coral, however, did not show indications of stress when exposed to 1 ppm and 5 ppm of dispersed oil for 24 hours (Wyers et al., 1986). *Diploria strigosa* exposed to dispersed oil (20:1, oil:dispersant) showed an 85 percent reduction in zooxanthellae photosynthesis after 8 hours of exposure to the mixture (Cook and Knap, 1983). However, the response was short-term, as recovery occurred between 5 and 24 hours after exposure and return to clean seawater. Investigations 1 year after *Diploria strigosa* was exposed to concentrations of dispersed oil between 1 and 50 ppm for periods between 6 and 24 hours did not reveal any impacts to growth (Dodge et al., 1984; Knap et al., 1983). It should be noted, however, that subtle growth effects may have occurred but were not measurable (Knap et al., 1983).

Historical studies indicated that dispersed oil appeared to be more toxic to coral species than oil or dispersant alone. The greater toxicity may be a result of an increased number of oil droplets, resulting in a greater contact area between the dispersed oil and water (Elgershuizen and De Kruijf, 1976). The dispersant results in a higher water soluble fraction of oil contacting the cell membranes of the coral (Elgershuizen and De Kruijf, 1976). The mucus produced by coral, however, can protect an organism from oil. Both hard and soft corals have the ability to produce mucus, and mucus production has been shown to increase when corals are exposed to crude oil (Mitchell and Chet, 1975; Ducklow and Mitchell, 1979). Dispersed oil, which has very small oil droplets, does not appear to adhere to coral mucus, and larger untreated oil droplets may become trapped by the mucus barrier (Knap, 1987; Wyers et al., 1986). However, entrapment of the larger oil droplets may increase long-term exposure to oil if the mucus is not shed in a timely manner (Knap, 1987; Bak and Elgershuizen, 1976).

More recent field studies did not reveal as great an impact of dispersants on corals as were indicated in historical toxicity tests (Yender and Michel, 2010). This difference in reported damage probably resulted from a more realistic application of dispersants in an open field system and because newer dispersants are less toxic than the older ones (Yender and Michel, 2010). Field studies have shown oil to be dispersed to the part per billion level minutes to hours after the dispersant application, which is orders of magnitude below the reasonable effects threshold of oil in the water column (20 ppm) measured in several studies (McAuliffe, 1987; Shigenaka, 2001).

Although dispersed oil may be toxic to corals during exposure experiments (Shafir et al., 2007; Wyers et al., 1986; Cook and Knap, 1983), untreated oil may remain in the ecosystem for long periods of time, while dispersed oil does not (Baca et al., 2005; Ward et al., 2003). Twenty years after an experimental oil spill in Panama, oil and impacts from untreated oil were still observed at oil treatment sites, but no oil or impacts were observed at dispersed oil or reference sites (Baca et al., 2005). Long-term recovery of the coral at the dispersed oil site had already occurred as reported in a 10-year monitoring update, and the site was not significantly different from the reference site (Ward et al., 2003).

The time of year and surrounding ecosystem must be considered when determining if dispersants should be used. Dispersant usage may result in reduced or shorter term impacts to coral reefs; however, it may increase the impacts to other communities, such as mangroves (Ward et al., 2003). Therefore, dispersant usage may be more applicable offshore than in coastal areas where other species may be impacted as well. In addition, dispersant use may be restricted in some areas during peak coral spawning periods (e.g., August-September for major reef-building species) (Gittings et al., 1992c and 1994) in order to limit the impacts of oil pollution on the near-surface portion of the water column.

Oil Adsorbed to Sediment Particles

Smaller suspended oil droplets could be carried to the seafloor as a result of oil droplets adhering to suspended particles in the water column. Smaller particles have a greater affinity for oil (Lewis and Aurand, 1997). Oil may also reach the seafloor through consumption by plankton with excretion distributed over the seafloor (ITOPF, 2007). Oiled sediment that settles to the seafloor may affect organisms attached to topographic features. It is anticipated that the greatest amount of oil adsorbed to sediment particles would occur close to the spill, with lesser concentrations farther from the source. Studies after a spill that occurred at the Chevron Main Pass Block 41C Platform in the northern Gulf of Mexico revealed that the highest concentrations of oil in the sediment were close to the platform and that the oil settled to the seafloor within 5-10 mi (8-16 km) of the spill site (McAuliffe et al., 1975). Therefore, if the spill occurs close to a topographic feature, the underlying benthic communities may become smothered by the particles and exposed to toxic hydrocarbons. However, because of the implementation of the No Activity Zone and surrounding 152-m (500-ft) buffer zone, topographic features should be distanced from the heaviest oiled sedimentation effects. Oiled sediment depositional impacts, however, are possible and may smother nearby benthic species.

Some oiled particles may become widely dispersed as they travel with currents while they settle out of suspension. Settling rates are determined by size and weight of the particle, salinity, and turbulent mixing in the area (Poirier and Thiel, 1941; Bassin and Ichiye, 1977; Deleersbijder et al., 2006). Because particles would have different sinking rates, the oiled particles would be dispersed over a large area, most likely at sublethal or immeasurable levels. Studies conducted after the *Ixtoc* oil spill revealed that, although oil was measured on particles in the water column, measurable petroleum levels were not found in the underlying sediment (ERCO, 1982). Based on BOEMRE's restrictions and the settling rates and behavior of oil adsorbed to sediment particles, the majority of organisms that may be exposed to oil adsorbed to sediment particles are anticipated to experience low-level concentrations.

Some oil, however, could reach topographic features as particles with adhered oil settle out of the water column. Sublethal impacts to benthic organisms from such exposure may include reduced recruitment success, reduced growth, and reduced coral cover as a result of impaired recruitment. Experiments have shown that the presence of oil on available substrate for larval coral settlement has inhibited larval metamorphosis and larval settlement in the area (Kushmaro et al., 1997). Crude oil concentrations as low as 0.1 ppm on substrate upon which the coral larvae were to settle reduced larval metamorphosis occurrences by 50 percent after 8 days of exposure. Oil concentrations of 100 ppm on substrates resulted in only 3.3 percent of the test population metamorphosizing (Kushmaro et al., 1997). There were also an increased number of deformed polyps after metamorphosis due to oil exposure (Kushmaro et al., 1997). It is also possible that recurring exposure may occur if oil adsorbed to sediment particles is resuspended locally, possibly inhibiting coral growth and recovery in the affected areas (Guzmán et al., 1994). Oil stranded in sediment is reportedly persistent and does not weather much (Hua, 1999), so coral may be repeatedly exposed to low concentrations of oil.

Adult coral, however, may be able to protect itself from low concentrations of oil adsorbed to sediment particles by production and sloughing of mucus. Coral mucus may act as a barrier to protect coral from the oil in the water column, and it has been shown to aid in the removal of oiled sediment on coral surfaces (Bak and Elgershuizen, 1976). Corals may use a combination of increased mucus production and ciliary action to rid themselves of oiled sediment (Bak and Elgershuizen, 1976).

Blowout and Sedimentation

Oil or gas well blowouts are possible occurrences in the OCS. Benthic communities exposed to large amounts of resuspended sediments following a subsurface blowout could be subject to sediment suffocation, exposure to toxic contaminants, and reduced light. Should oil or condensate be present in the blowout flow, liquid hydrocarbons could be an added source of negative impact on the benthos.

Turbid waters would have less light penetrating to depth, which may result in reduced photosynthesis by the symbiotic zooxanthellae that live in coral tissue (Rogers, 1990). Long-term exposures to turbidity have even resulted in significantly reduced skeletal extension rates in the scleractinian coral *Montastraea annularis* (Torres, 2001; Dodge et al., 1974) and an acute decrease in calcification rates of *Madracis mirabilis* and *Agaricia agaricites* (Bak, 1978). The higher the concentration of suspended sediment in the water column and the longer the sediment remains suspended, the greater the impact.

Suspended sediment that is transported by currents deep in the water column should not impact the benthic organisms on the upper portions of topographic features. Studies have shown that deep currents sweep around topographic features instead of over them, allowing the suspended sediment to remain at depth (Rezak et al., 1983; McGrail, 1982). Therefore, suspended sediment from depth should not be deposited on top of the elevated benthic organisms. Organisms on the lower levels around topographic features are frequently enveloped in a turbid nepheloid layer; organisms surviving here are tolerant of heavy turbidity.

Sediment that settles out of upper layers of the water column may impact benthic organisms of topographic features. Sediment deposition may smother benthic organisms, decreasing gas exchange, increasing exposure to anaerobic sediment, reducing light intensity, and causing physical abrasion (Wilber et al., 2005). Corals may experience reduced colony coverage, changes in species diversity and dominance patterns, alterations in growth rates and forms, decreased calcification, decreased photosynthesis, increased respiration, increased production in mucus, loss of zooxanthellae, lesions, reduced recruitment, and mortality (Torres et al., 2001; Telesnicki and Goldberg, 1995). Coral larvae settlement may also be inhibited in areas where sediment has covered available substrate (Rogers, 1990; Goh and Lee, 2008).

Impacts to corals as a result of sedimentation would vary based on coral species, the height to which the coral grows, degree of sedimentation, length of exposure, burial depth, and the coral's ability to clear the sediment. Impacts may range from sublethal effects such as reduced growth, alteration in form, reduced recruitment and productivity, and slower growth to death (Rogers, 1990).

Corals have some ability to rid themselves of sediment through mucus production and ciliary action (Marszalek, 1981; Bak and Elgershuizen, 1976; Telesnicki and Goldberg, 1995). Scleractinian corals are tolerant of short-term sediment exposure and burial, but longer exposures may result in loss of zooxanthellae, polyp swelling, increased mucus production, reduced coral growth, and reduced reef development (Marszalek, 1981; Rice and Hunter, 1992). Bleached tissue as a result of sediment exposure has been reported to recover in approximately a month (Wesseling et al., 1999).

Solitary octocorals and gorgonians, which are found on many hard-bottom features, are more tolerant of sediment deposition than colony-forming scleractinian corals because the solitary species grow erect and are flexible, reducing sediment accumulation and allowing easy removal (Marszalek, 1981; Torres et al., 2001; Gittings et al., 1992b). Branching and upright forms of scleractinian corals, such as *Madracis mirabilis* and *Agaricia agaricites*, also tend to be more tolerant of sediment deposition than massive, plating, and encrusting forms, such as *Porites astreoides* (Roy and Smith, 1971; Bak, 1978). Some of the more sediment-tolerant scleractinian species in the Gulf of Mexico include *Montastraea cavernosa*, *Siderastrea siderea*, *Siderastrea radians*, and *Diploria strigosa* (Torres et al., 2001; Acevedo et al., 1989; Loya, 1976a).

Since the BOEMRE-proposed stipulation would preclude drilling within 152 m (500 ft) of the No Activity Zone, most adverse effects on topographic features from blowouts would be prevented. Petroleum-producing activities would be far enough removed that heavy layers of sediment that may become resuspended as a result of a blowout should settle out of the water column before they reach sensitive biological communities. Other particles that travel with currents should become dispersed as they travel, reducing turbidity or depositional impacts. Furthermore, sediment traveling at depth should remain at depth instead of rising to the top of topographic features.

Response Activity Impacts

Oil-spill-response activity may also affect sessile benthic communities on topographic features. Booms anchored to the seafloor are sometimes used to control the movement of oil at the water surface. Boom anchors can physically damage corals and other sessile benthic organisms, especially when booms are moved around by waves (Tokotch, 2010). Vessel anchorage and decontamination stations set up during response efforts may also break or kill hard-bottom features as a result of setting anchors. Spill response, especially in the case of a catastrophic spill, can involve activity by varied organizations, including many that are not coordinated by the oil-spill-response plan. While the spill-response plan and activities coordinated by responsible agencies such as NOAA and USCG would avoid damaging sensitive habitats, the risk remains that some other responders may not be aware of all the sensitive habitats of concern. Injury to coral reefs as a result of anchor contact may result in long-lasting damage or failed recovery (Rogers and Garrison, 2001). Effort should be made to keep vessel anchorage areas far from sensitive benthic features to minimize impact.

Drilling muds comprised primarily of barite may be pumped into a well to stop a blowout. If a "kill" is not successful, the mud may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath the extruded drilling mud would be buried. Based on BOEMRE's proposed stipulation (NTL 2009-G39), a well should be far enough away from topographic features to prevent extruded drilling muds from smothering sensitive benthic communities. It is more likely that benthic organisms on topographic features would experience turbidity or light layers of sedimentation due to a blowout based on BOEMRE's proposed stipulation. Turbidity impacts may result in reduced photosynthesis or growth (Rogers, 1990; Torres, 2001). Light layers of deposited sediment would most likely be removed by mucus and ciliary action (Marszalek, 1981; Bak and Elgershuizen, 1976; Telesnicki and Goldberg, 1995).

Proposed Topographic Features Stipulation

The proposed Topographic Features Stipulation would preclude drilling within 152 m (500 ft) of a No Activity Zone to prevent adverse effects from nearby drilling on topographic features. The BOEMRE has created a No Activity Zone around topographic features in order to protect these habitats from disruption due to oil and gas activities. A No Activity Zone is a protective perimeter drawn around each feature that is associated with a specific isobath (depth contour) surrounding the feature in which structures, drilling rigs, pipelines, and anchoring are not allowed. These No Activity Zones are areas protected by BOEMRE policy. The NTL 2009-G39 recommends that drilling would not occur within 152 m (500 ft) of a No Activity Zone of a topographic feature. This additional recommendation is based on essential fish habitat, and construction within the essential fish habitat would require project-specific consultation with NOAA.

Although BOEMRE's proposed stipulation prevents oil and gas drilling activity within 152 m (500 ft) of the No Activity Zone of topographic features, some sublethal effects may occur to benthic organisms as a result of an oil spill despite this 152-m (500-ft) buffer. Sublethal impacts may include exposure to low levels of oil, dispersed oil, or oil adsorbed to sediment particles and turbidity and sedimentation from disturbed sediments. Impacts from these exposures may include reduced photosynthesis, reduced growth, altered behavior, decreased community diversity, altered community composition, reduction in coral cover, and reduced reproductive success. The severity of these impacts may depend on the concentration and duration of exposure.

Proposed Action Analysis

All of the topographic features in the WPA are found in water depths less than 200 m (656 ft). They represent a small fraction of the continental shelf area in the WPA. The fact that the topographic features are widely dispersed, combined with the probable random nature of oil-spill locations, serves to limit the extent of damage from any given oil spill to the topographic features.

The proposed Topographic Features Stipulation (**Chapters 2.3.1.3.1.)** would assist in preventing most of the potential impacts from oil and gas operations, including accidental oil spills and blowouts, on the biota of topographic features. However, operations outside the No Activity Zone (including blowouts and oil spills) may still affect topographic features.

The depth below the sea surface to which many topographic features rise helps to protect them from surface oil spills. The East Flower Garden Bank rises to within 15 m (49 ft) of the sea surface, and the West Flower Garden Bank rises to within 18 m (59 ft). Any oil that might be driven to 15 m (49 ft) or deeper would probably be at concentrations low enough to reduce impact to these features.

A subsurface spill or plume may impact sessile biota of topographic features. Oil or dispersed oil may cause sublethal impacts to benthic organisms if a plume reaches these features. Impacts may include loss of habitat, biodiversity, and live coverage; change in community structure; and failed reproductive success. The proposed Topographic Features Stipulation would limit the potential impact of such occurrences by keeping the sources of such adverse events geographically removed from the sensitive biological resources of topographic features.

Oil adsorbed to sediment particles or sedimentation as a result of a blowout may impact benthic organisms. However, the proposed Topographic Features Stipulation places petroleum-producing activity at a distance from topographic features, resulting in reduced turbidity and sedimentation, and any oil adsorbed to sediment particles should be well dispersed, resulting in a light layer of deposition that would be removed by the normal self-cleaning processes of benthic organisms.

Summary and Conclusion

The proposed Topographic Features Stipulation, if applied, would assist in preventing most of the potential impacts on topographic feature communities from blowouts, surface, and subsurface oil spills and the associated effects by increasing the distance of such events from the topographic features. It would be expected that the majority of oil would rise to the surface and that the most heavily oiled sediments would likely be deposited before reaching the topographic features. Any contact with spilled oil would likely cause sublethal effects to benthic organisms because the distance of activity would prevent contact with concentrated oil. In the unlikely event that oil from a subsurface spill would reach the biota of a topographic feature, the effects would be primarily sublethal and impacts would be at the community level. Any turbidity, sedimentation, and oil adsorbed to sediment particles would also be at low concentrations by the time the topographic features were reached, also resulting in sublethal impacts. Impacts from an oil spill on topographic features are also lessened by the distance of the spill to the features, the depth of the features, and the currents that surround the features.

Effects of the Proposed Action without the Proposed Stipulation

The topographic features and associated coral reef biota of the WPA could be damaged by oil and gas activities resulting from the proposed action should they not be restricted by application of the proposed Topographic Features Stipulation. This would be particularly true should operations occur directly on top of or in the immediate vicinity of otherwise protected topographic features. The area within the No Activity Zone would probably be the areas of the topographic features that are most susceptible to adverse impacts if oil and gas activities are unrestricted by the proposed Topographic Features Stipulation or project-specific mitigating measures. These impacting factors would include blowouts, surface oil spills, and subsea oil spills, along with oil-spill-response activities such as the use of dispersants. Potential impacts from routine activities resulting from the proposed action are discussed in **Chapter 4.1.1.6.2**.

Oil spills as well as routine activities have the potential to considerably alter the diversity, cover, and long-term viability of the reef biota found within the No Activity Zone if the proposed Topographic Features Stipulation is not applied. Direct oil contact may result in acute toxicity (Dodge et al., 1984; Wyers et al., 1986). In most cases, recovery from disturbances would take 10 years or more (Fucik et al., 1984; Rogers and Garrison, 2001). Dispersants should not be applied near sensitive areas such as coral communities, according to NOAA Policy (Gittings, 2006). Although not specifically regulated by BOEMRE's proposed stipulation, their possible use is physically distanced by buffer zones created by BOEMRE stipulations. Dispersants could be applied at a spill close to sensitive features if the buffer zone between petroleum-producing activity and a sensitive feature is not enforced through stipulations. Indeed, disturbances, including oil spills and blowouts, would alter benthic substrates and their associated biota over large areas. In the unlikely event of a blowout, sediment resuspension potentially associated with oil could cause adverse turbidity and sedimentation conditions. In addition to affecting the live cover of a topographic feature, a blowout could alter the local benthic morphology, thus irreversibly altering the reef community. Oil spills (surface and subsea) could be harmful to the local biota should the oil have a prolonged or recurrent contact with the organisms. Therefore, in the absence of the proposed Topographic Features Stipulation, the proposed action could cause long-term (10 years or more) adverse impacts to the biota of the topographic features in the event of a spill

4.1.1.6.4. Cumulative Impacts

The proposed Topographic Features Stipulation is assumed to be in effect for this cumulative analysis. The continued application of this proposed stipulation would prevent any direct adverse impacts on the biota of the topographic features, i.e., impacts potentially generated by oil and gas operations. The cumulative impact from routine oil and gas operations includes effects resulting from the proposed action, as well as those resulting from past and future OCS leasing. These operations include anchoring, structure emplacement, muds and cuttings discharge, effluent discharge, blowouts, oil spills, and structure removal. Potential non-OCS-related factors include vessel anchoring, treasure-hunting activities, import tankering, heavy storms and hurricanes, the collapse of the tops of the topographic features due to dissolution of the underlying salt structure, commercial fishing, and recreational scuba diving.

Mechanical damage, including anchoring, is considered to be a catastrophic threat to the biota of topographic features. The proposed Topographic Features Stipulation prohibits oil and gas leaseholders from anchoring vessels and placing structures within 152 m (500 ft) of the No Activity Zone around topographic features (**Chapter 2.3.1.3.1**) (USDOI, MMS, 2009b); the proposed stipulation does not affect other non-OCS activities such as fishing, recreational scuba diving, or anchoring other vessels on or near these features. Many of the topographic features are found near established shipping fairways and are well-known fishing areas. The Flower Garden Banks National Marine Sanctuary allows conventional hook and line fishing within the boundaries of the Sanctuary, which includes Stetson Bank (USDOC, NOAA, 2010h). Also, the Flower Garden Banks and several of the shallower topographic features are frequently visited by scuba divers aboard recreational vessels (Hickerson et al., 2008). Anchoring at a topographic feature by a vessel involved in any of these activities could damage the biota. The degree of damage would depend on the size of the anchor and chain (Lissner et al., 1991). Anchor damages incurred by benthic organisms may take more than 10 years to recover, depending on the extent of the damage (Fucik et al., 1984; Rogers and Garrison, 2001). The Flower Garden Banks National Marine Sanctuary prohibits all anchoring within its boundaries and has installed numerous mooring buoys at the

East and West Flower Garden Banks and Stetson Bank to support recreational activities (USDOC, NOAA, 2010h).

The use of explosives in treasure-hunting operations has become a concern on topographic features; several large holes and serious damage has occurred on Bright Bank in the CPA, which has resulted in the loss of coral cover (Schmahl and Hickerson, 2006). The recovery from such destructive activity may take in excess of 10 years and would depend on the type and extent of damage incurred by individual structures (Fucik et al., 1984; Rogers and Garrison, 2001). This activity is not governed by BOEMRE or NOAA and could impact topographic features in the WPA.

Impacts from natural occurrences such as hurricanes occasionally result in damage to the biota of the topographic features. When Hurricane Rita passed 95 km (60 mi) east of the East Flower Garden Bank, coral colonies were toppled, sponges and fields of finger coral (*Madracis mirabilis*) were broken, coral tissues were damaged by suspended sand and rocks, and large-scale shifts occurred in sand patches (Hickerson et al., 2008; Hickerson and Schmahl, 2007; Robbart et al., 2009). Hurricane Katrina may have caused serious damage on Sonnier Bank farther east. Another possible natural impact to the banks would be the dissolution of the underlying salt structure, leading to collapse of the reef (Seni and Jackson, 1983). Dissolution of these salt structures is unlikely and beyond regulation abilities.

Depending on the levels of fishing pressure exerted, fishing activities that occur at the topographic features may impact local fish populations. The collecting activities by scuba divers on shallow topographic features may have an adverse impact on the local biota. Collecting is prohibited at the Flower Garden Banks National Marine Sanctuary (USDOC, NOAA, 2010h). Anchoring during recreational and fishing activities, however, would be the source of the majority of severe impacts incurred by the topographic features.

The continued application of the proposed Topographic Features Stipulation precludes anchoring on topographic features by oil- and gas-related operations. Detrimental impacts would result if oil and gas operators anchored pipeline barges, drilling rigs, and service vessels or if they placed structures on topographic features (Rezak and Bright, 1979; Rezak et al., 1985). The proposed Topographic Features Stipulation restricts these activities within 152 m (500 ft) of the No Activity Zone around topographic features, thus preventing adverse impacts on benthic communities of topographic communities (USDOI, MMS, 2009b).

The routine discharge of drilling muds and cuttings is restricted in the vicinity of topographic features. It is estimated that approximately 2,000 metric tons of drill cuttings are discharged for exploratory wells (900 metric tons of drilling fluid and 1,100 metric tons of cuttings) and slightly lower discharges for development wells (Neff, 2005). Continued application of the proposed Topographic Features Stipulation would require lease operators to comply with measures, such as shunting that would keep discharged materials at depths below sensitive biota.

The USEPA, through its NPDES discharge permit, also enacts further mitigating measures on discharges. As noted above under routine events of the proposed action, drilling fluids can be moderately toxic to marine organisms (the more toxic effluents are not allowed to be discharged under NPDES permits), and their effects are restricted to areas closest to the discharge point, thus preventing contact with the biota of topographic features (Montagna and Harper, 1996; Kennicutt et al., 1996). Small amounts of drilling effluent in low concentrations may reach a bank from wells outside the No Activity Zone; however, these amounts, if measurable, would be extremely small and would be restricted to small areas with little effect on the biota.

The proposed Topographic Features Stipulation protects topographic features by mandating a physical distance from drilling activities. Drilling fluid plumes are rapidly dispersed on the OCS; approximately 90 percent of the material discharged in drilling a well (cuttings and drilling fluid) settles rapidly to the seafloor, while 10 percent forms a plume of fine mud that drifts in the water column (Neff, 2005). Shunting of drill muds and cutting is required for wells drilled in the vicinity of topographic features. Shunting restricts the cuttings to a smaller area and places the turbidity plume near the seafloor where the environment is frequently turbid and benthic communities are adapted to high levels of turbidity. Water currents moving turbidity plumes across the seafloor would sweep around topographic features rather than carrying the turbidity over the banks (Bright and Rezak, 1978). Any sediment that may reach coral can be removed by the coral using tentacles and mucus secretion, and physically removed by currents that can shed the mucus-trapped particles from the coral (Shinn et al., 1980; Hudson and Robin, 1980).

With the inclusion of the proposed Topographic Features Stipulation, no discharges of effluents, including produced water, would take place within the No Activity Zone. Drill cuttings in areas around the No Activity Zone would be shunted to within 10 m (33 ft) of the seabed. This procedure, combined with USEPA's discharge regulations and permits, should eliminate the threat of discharges reaching and affecting the biota of a topographic high. The impacts that these discharges could cause would be primarily sublethal damages that could lead to a possible disruption or impairment of a few elements at a local scale, but no interference to the general ecosystem performance should occur.

Impacts on the topographic features could occur as a result of oil- and gas-related spills or spills from import tankering. Due to dilution and the depths of the crests of the topographic features, discharges should not reach topographic features in sufficient concentrations to cause impacts. Tanker accidents would result in surface oil spills, which generally do not mix below a depth of 10-20 m (33-66 ft) (Lange, 1985; McAuliffe et al., 1975 and 1981a; Tkalich and Chan, 2002), which should protect most topographic features, very few of which rise to within 15 m (50 ft) of the sea surface. Any dispersed surface oil from a tanker spill that may reach the benthic communities of topographic features in the Gulf of Mexico would be expected to be at very low concentrations (less than 1 ppm) (McAuliffe et al., 1981a and 1981b; Lewis and Aurand, 1997). Such concentrations would not be life threatening to larval or adult stages based on experiments conducted with coral (Lewis, 1971; Elgershuizen and De Kruijf, 1976; Knap, 1987; Wyers et al., 1986; Cohen et al., 1977) and observations after oil spills (Jackson et al., 1989; Guzmán et al., 1991). Any dispersed or physically mixed oil in the water column that comes in contact with corals, however, may evoke short-term negative responses by the organisms, such as reduced feeding and photosynthesis or altered behavior (Wyers et al., 1986; Cook and Knap, 1983; Dodge et al., 1984).

Potential blowouts could impact the biota of the topographic features. Based on the proposed Topographic Features Stipulation, few blowouts, if any, would reach the No Activity Zone around the topographic features. The proposed stipulation creates a buffer zone around the banks that would protect them from direct impacts by damaging amounts of suspended sediment from a seafloor blowout. Most of the oil from a seafloor blowout would rise to the surface, but some of it may be entrained in the water column as a subsea plume. Oil in a subsea plume could be carried to a topographic feature. The resulting level of impacts depends on the concentration of the oil when it contacts the habitat. The farther the blowout is from the topographic feature, the more dispersed the oil and sediment would become, reducing the possible impacts. Also, because currents sweep around topographic features instead of over them, subsea oil should be directed away from the more sensitive communities on the upper levels of topographic features (Rezak et al., 1983; McGrail, 1982). If oil were to contact the topographic features, the impacts may include loss of habitat, biodiversity, and live coverage; change in community structure; and failed reproductive success. In the highly unlikely event that oil from a subsurface spill could reach a coral-covered area in lethal concentrations, the recovery of this area could take in excess of 10 years (Fucik et al., 1984).

The cumulative impact of the DWH event on the WPA, if any, is anticipated to be small. The Macondo well was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). No visual observations of oil have been reported in or near the Flower Garden Banks National Marine Sanctuary as a result of the DWH event (Schmahl, official communication, 2011). Based on the distance of the WPA from the Macondo well and the fact that the westernmost extent of the sheen from the DWH event remained east of the WPA, it is not expected that any information released as part of the NRDA process following the DWH event would impact BOEMRE's analysis of topographic features in the WPA or the potential incremental impact on these features. This information, therefore, is not essential to a reasoned choice among the alternatives analyzed in this Supplemental EIS.

Platforms would be removed from the OCS Program each year; some may be in the vicinity of topographic features (**Table 3-2**). However, the proposed Topographic Features Stipulation prevents the installation of platforms near the No Activity Zone, thus reducing the potential for impact from platform removal. The explosive removals of platforms are far enough away to prevent impacts to the biota of the topographic features.

Summary and Conclusion

Activities causing mechanical disturbance represent the greatest threat to the topographic features. This would, however, be prevented by the continued application of the proposed Topographic Features Stipulation. Potential OCS-related impacts include anchoring of vessels and structure emplacement, operational discharges (drilling muds and cuttings, and produced waters), blowouts, oil spills, and structure removal.

The proposed Topographic Features Stipulation would preclude mechanical damage caused by oil and gas leaseholders from impacting the benthic communities of the topographic features and would protect them from operational discharges by establishing a buffer around the features. As such, little impact would be incurred by the biota of the topographic features. The USEPA discharge regulations and permits would further reduce discharge-related impacts.

Blowouts could potentially cause damage to benthic biota; however, due to the application of the proposed Topographic Features Stipulation, blowouts would not reach the No Activity Zone surrounding the topographic features and associated biota, resulting in little impact on the features. If a subsea oil plume is formed, it could contact the habitats of a topographic feature; this contact may be restricted to the lower, less sensitive levels of the banks and/or may be swept around the banks with the prevailing water currents. The farther the oil source is from the bank, the more dilute and degraded the oil would be when it reaches the vicinity of the topographic features.

Oil spills can cause damage to benthic organisms when the oil contacts the organisms. The proposed Topographic Features Stipulation would keep sources of OCS spills at least 152 m (500 ft) away from the immediate biota of the topographic features. In the unlikely event that oil from a subsurface spill would reach the biota of a topographic feature, the effects would be primarily sublethal for corals and much of the other fully developed biota. In the event that oil from a subsurface spill reached an area containing hermatypic coral cover (e.g., the Flower Garden Banks and Stetson Bank) in lethal concentrations, the recovery could take in excess of 10 years (Fucik et al., 1984). Finally, in the unlikely event a freighter, tanker, or other oceangoing vessel related to OCS Program activities or non-OCS-related activities sank and proceeded to collide with the topographic features or associated habitat releasing its cargo, recovery could take years to decades, depending on the extent of the damage. Because these events are rare in occurrence, the potential of impacts from these events is considered low.

Non-OCS activities could mechanically disrupt the bottom (such as anchoring and treasure-hunting activities, as previously described). Natural events such as hurricanes or the collapse of the tops of the topographic features (through dissolution of the underlying salt structure) could cause severe impacts. The collapsing of topographic features is unlikely and would impact a single feature. Impacts from scuba diving, fishing, ocean dumping, and discharges or spills from tankering of imported oil could have detrimental effects on topographic features.

Overall, the incremental contribution of the WPA proposed action to the cumulative impact is negligible when compared with non-OCS impacts. Where the proposed Topographic Features Stipulation is applied, mechanical impacts (anchoring and structure emplacement) and impacts from operational discharges (produced waters, drilling fluids, cuttings) or accidental discharges (oil spills, blowouts) would be removed from the immediate area surrounding the topographic features.

4.1.1.7. Sargassum

A description of *Sargassum* as a resource has not been included in previous NEPA evaluations conducted in the Gulf of Mexico by BOEMRE. Therefore, there is no prior discussion in the Multisale EIS or the 2009-2012 Supplemental EIS upon which to tier or information from these documents that could be incorporated by reference.

4.1.1.7.1. Description of the Affected Environment

Sargassum is one of the most ecologically important brown algal genera found in the pelagic environment of tropical and subtropical regions of the world. The pelagic complex in the GOM is mainly comprised of *S. natans* and *S. fluitans* (Lee and Moser, 1998; Stoner, 1983; Littler and Littler, 2000). Both species of macrophytes (aquatic plants) are hyponeustonic (living immediately below the surface) and fully adapted to a pelagic existence (Lee and Moser, 1998). Also known as gulf-weed or sea holly

(Coston-Clements et al., 1991; Lee and Moser, 1998), *Sargassum* is characterized by a brushy, highly branched thallus (stem) with numerous leaf-like blades and berrylike pneumatocysts (air bladders or floats) (Coston-Clements et al., 1991; Lee and Moser, 1998; Littler and Littler, 2000). The air bladders contain mostly oxygen with some nitrogen and carbon dioxide, allowing for buoyancy. These floating plants may be up to a few meters in length and may be found floating alone or in larger rafts or mats that support communities of fish and a variety of other marine organisms. The distribution, size, and abundance of *Sargassum* mats varies depending on environmental and physiochemical factors such as temperature, salinity, and dissolved oxygen.

Habitat

Sargassum provides islands of high energy and carbon content in an otherwise nutrient and carbon poor environment (Stoner, 1983). Sargassum mats support a diverse assemblage of marine organisms including micro- and macro-epiphytes (plants that grow on plants) (Carpenter and Cox, 1974; Coston-Clements et al., 1991), fungi (Winge, 1923), more than 100 species of invertebrates (Coston-Clements et al., 1991), over 100 species of fish (Dooley, 1972; Stoner, 1983), four species of sea turtles (Carr, 1987; Manzella et al., 2001), and various marine birds (Lee and Moser, 1998). *Sargassum* serves as nurseries, sanctuaries, and forage grounds for both commercially and recreationally exploited species. Numerous epipelagic fish (fish in upper ocean waters, where light penetrates) use the *Sargassum* as a source of food, certain flying fish lay eggs in the floating mats, and other fish use it as nursery grounds (Adams, 1960; Bortone et al., 1977; Dooley, 1972). Sea turtles have been seen using the protective mats for passive migration as hatchlings (Carr and Meylan, 1980). These communities may also vary depending on the environmental and physiochemical factors known to affect *Sargassum*, resulting in variable species composition, life histories, and diversity. It has been noted that inshore *Sargassum* communities differ in species composition than offshore communities, due to the varied effects of salinity and dissolved oxygen. Recent findings suggest that *Sargassum* provides critical habitat that may have an influence on the recruitment success of several species (South Atlantic Fishery Management Council, 2002; Wells and Rooker, 2004).

Invertebrates

Epiphytic cyanobacteria contribute to overall production and nutrient recycling within the *Sargassum* complex (Wells and Rooker, 2004). The algae is colonized first by bacteria, followed by hydroids and bryozoans, which provide the base of a food web containing a variety of invertebrates, fishes, and sea turtles (Bortone et al., 1977; Dooley, 1972).

Both sessile and motile invertebrates are found within the *Sargassum* community. Epifauna (animals living on the substrate) include colonial hydroids, encrusting bryozoans, the polychaete *Spirorbis*, barnacles, sea spiders, and the tunicate *Diplosoma*. Older plants can become heavily encrusted with these organisms, causing them to sink to the seafloor. A sunken mat will eventually disintegrate, providing further nourishment for animals in deeper water (Coston-Clements et al., 1991; Parr, 1939). Some of the motile fauna found within the floating communities will include polychaetes, flatworms, nudibranchs, decapod crustaceans (such as *Latreutes* and *Leander* shrimps and *Portunus* crabs), and various molluscs (including the *Sargassum* snail *Litiopa melanostoma*) (Parr, 1939).

Fish

Fish assemblages in *Sargassum* mats located in the GOM and the Atlantic have shown similarities in species composition. In studies by Dooley (1972) and Bortone et al. (1977), 90-97 percent of the total catch was represented by jacks, pompanos, jack mackerels, scads, triggerfish, filefish, seahorse, pipefish, and frogfish in both regions. The abundance of juvenile fish associated with these mats suggests that they serve as an important nursery habitat for numerous species, including filefish, sergeant majors, tripletail, silver mullet, flying fish, and various jacks (Dooley, 1972). Some species that are endemic to *Sargassum* utilize the habitat for early life stages as well as adult stages, while other species may rely on the habitat only as a source of food and protection during early life stages (Wells and Rooker 2004). The patterns of habitat use by many of the juvenile fish associated with *Sargassum* have exhibited spatial and temporal variability. Monthly influences such as environmental conditions appear to have an important role in the

Sargassum fish assemblages within the northwestern GOM. By serving as an important nursery habitat for pelagic, benthic, and even estuarine species, *Sargassum* may have influence on the recruitment success of the fishes using it as habitat.

The importance of *Sargassum* differs among species depending on its role as essential fish habitat. The NMFS has designated *Sargassum* as essential fish habitat in the south Atlantic (Coston-Clements, 1991; USDOC, NMFS, 2010a). However, more studies are needed in order to evaluate the importance of *Sargassum* as habitat in the northwestern GOM, where *Sargassum* is the predominant cover and structure offering habitat for pelagic species at the sea surface.

Sea Turtles

Four of the five species of sea turtles found in the GOM are associated with floating *Sargassum* (Carr and Meylan, 1980; Carr, 1987; Coston-Clements et al., 1991; Schwartz, 1988). The hatchlings of loggerhead (*Caretta caretta*), green (*Chelonia mydas*), Kemp's ridley (*Lepidochelys kempii*), and hawksbill (*Eretmochelys imbricata*) sea turtles are thought to find the *Sargassum* rafts when actively seeking frontal zones, then utilizing the habitat as foraging grounds and protection during their pelagic "lost years" (juvenile years in which turtle sightings are scarce) (Carr, 1987; Coston-Clements et al., 1991). Schwartz (1988) reported numerous loggerhead hatchlings during commercial trawling for *Sargassum* in the Atlantic. This provided the largest count of hatchlings on record to date. After Hurricane David hit the Gulf in September 1979, Carr and Meylan (1980) collected dead and live turtles that were found in the *Sargassum* mats that had washed up on Cocoa Beach. The stomach content of the turtles was solely *Sargassum* floats and leafy parts, further emphasizing the importance of the habitat for pelagic growth stages of sea turtles.

Birds

A study by Lee and Moser (1998) found that the presence or absence of *Sargassum* drives local abundance and occurrence of certain species of marine birds. Various avian species utilize the resource in specific ways, by feeding on small fishes and other organisms in the *Sargassum* communities. In Lee and Moser's study, birds with over 25 percent of their prey living in *Sargassum* are classified as *Sargassum* specialists. Specialist species included shearwaters (59%), masked boobies (100%), phalaropes (62%), and various species of terns (40-60%). Both the GOM and Atlantic pelagic environment provide nutrient poor surface waters with low productivity. Therefore, the importance of this highly productive *Sargassum* community to seabird abundance and seasonal distribution is assumed to be high.

Distribution

Approximately 1 million wet cubic tons of *Sargassum* (*natans* and *fluitans*) is estimated to grow and circulate in the GOM annually. Over 80 percent of this is the dominant species *S. natans* (Parr, 1939). Wells and Rooker (2004) suggest that the abundance and age of *Sargassum* increases when found in slow-moving gyres, such as found in the western GOM and the Sargasso Sea (middle of the North Atlantic). These waters provide the ideal environment for *Sargassum* to grow and provide abundant habitat for associated organisms (Dooley, 1972).

Research by Gower and King (2008) suggests that the northwest GOM is the "major nursery area" for *Sargassum* that supplies the Atlantic population. The transportation of these plants is influenced by winds and ocean currents, and the winds over the Gulf blow predominantly from the east to the west and adjacent waters move from the west to the east (Parr, 1939; Rhodes et al., 1989). *Sargassum* originates in the northwestern GOM in March of each year, where it remains for long periods of time in the slowly rotating gyres of western GOM waters (Gower et al., 2006, Gower and King, 2008). In the months of May, June, and July, *Sargassum* is at its most abundant. The *Sargassum* begins to expand and spreads eastward into the central and eastern Gulf waters, taking up to 2 months to move across the Gulf, where it will eventually exit in the Loop Current. The movement of passive drift buoys deployed to track water currents corroborates this pattern of *Sargassum* movement from the Gulf to the Atlantic (Gower et al., 2006). It was previously assumed that *Sargassum* in the Atlantic originated in the Sargasso Sea. However Gower and King (2008) used satellite imagery to determine that the Loop Current and Gulf Stream are responsible for distributing a large amount of *Sargassum* from the GOM into the Atlantic near

Cape Hatteras in July and August. From September through February, the *Sargassum* that was distributed in the Atlantic mixes into the Sargasso Sea, loops around to the south, and dies in the waters north of the Bahamas, about a year after it originated in the GOM.

Historic Impacts on *Sargassum*

Studies by Parr (1939) and Stoner (1983) suggest that a significant decrease in *Sargassum* biomass has occurred from the 1930's through the 1980's, presumably because of increased pollutants and toxins in the pelagic environment. Burns and Teal (1973) found that *Sargassum* and its associates accumulate and concentrate petroleum hydrocarbons. An increase in petroleum pollution and associated toxic effects in the GOM may have attributed to the declining macrophyte populations. *Sargassum* has been noted to have higher levels of toxins than in surrounding water samples in polluted areas. Oceanographic processes that concentrate *Sargassum* into mats and rafts may also concentrate toxic substances. Therefore, it may be assumed that *Sargassum* will be found in areas where oil, dispersants, and other pollutants have accumulated since the DWH event.

The highest concentration of *Sargassum* in the GOM during the months of June and July was in the vicinity of the DWH event in the CPA. *Sargassum* populations in the CPA at the time would have been affected, while populations in the WPA were unaffected.

A broad Internet search for relevant new information, as well as a search for scientific journal articles, was conducted using a publicly available search engine. A search for relevant information gathered during the *Ixtoc* spill of 1979 was conducted. In addition, the websites for Federal and State agencies, as well as other organizations, were reviewed for newly released information. Sources investigated include the South Atlantic Fishery Management Council, coordinated communications with the Gulf of Mexico Alliance, USEPA, USGS, and coastal universities. Interviews with personnel from academic institutions and governmental resource agencies were conducted to determine the availability of new information. In addition, there are ongoing NOAA- and National Science Foundation-funded research projects that are investigating the *Sargassum* distribution and impacts from the DWH event.

4.1.1.7.2. Impacts of Routine Events

Proposed Action Analysis

Impact-producing factors associated with routine events for the WPA proposed action that could affect *Sargassum* may include (1) drilling discharges (muds and cuttings); (2) produced water and well treatment chemicals; (3) operational discharges (deck drainage, sanitary and domestic water, bilge and ballast water); and (4) physical disturbance from vessel traffic and the presence of exploration and production structures (i.e., rigs, platforms, and MODU's).

Drilling activities differ from other routine activities in the use of drilling muds and the discharge of drill cuttings. Modern drilling muds are typically synthetic-based muds. These muds are more costly than water-based muds and are routinely recycled rather than released. The USEPA regulates the composition of drilling muds to limit toxic components permitted for use. Some muds are released during initial spudding of the well (the first segment of the well, before the outer casing is installed); however, this release of drilling muds is at the seafloor. Since the muds are heavier than seawater, the muds and cuttings from the spudding process generally settle to the seafloor within about 100 m (328 ft) of the well site (CSA, 2006a). Therefore, this release at the seafloor would not affect the pelagic *Sargassum* community, which floats on and near the sea surface.

Drill cuttings are typically discharged from the drill platform (on or near the sea surface) during drilling. Drill cuttings are heavier than seawater and, when released at the sea surface in deep water, generally sink to the seafloor within less than 1,000 m (3,281 ft) of the well site (CSA, 2006a). Cuttings can contain some concentrations of naturally-occurring substances that are toxic, e.g., arsenic, cadmium, mercury, other heavy metals, and hydrocarbons (Neff, 2005). Hydrogen sulfide is also produced from some wells. In addition, some amount of drilling muds is included with the cuttings discharges, as the recycling process is not 100 percent efficient. However, the composition of muds is strictly regulated and discharges of cuttings/muds are tested to ensure that toxicity levels are below the limits allowed by NPDES permits (USEPA, 2004, 2007d, and 2009).

The routine discharge of drill cuttings and muds is expected to have little effect on *Sargassum* communities. There are three arguments that support this conclusion. First, as highlighted above, muds and cuttings are heavier than seawater, so they would sink relatively rapidly. This means that the *Sargassum* at or near the sea surface would only be exposed to contact with discharges for a short time. The *Sargassum* would be traveling laterally with the surface water current; at the same time, the muds and cuttings would be rapidly sinking toward the seafloor. Second, the toxicity of muds and cuttings is limited by applicable regulations, so effects can be expected to be low if *Sargassum* is contacted. Third, discharges affect only a localized area of the sea surface. The proposed action is estimated to result in a total of 287 wells in the WPA. While this may seem like a large number of wells, they would affect only a very small portion of the 115,645 km^2 (44,651 mi^2) of the WPA. Although *Sargassum* occurs in most of the northern GOM, it is not abundant, or even present, in all waters at all times. Therefore, only a small portion of pelagic *Sargassum* in the GOM would come in contact with drill cuttings and muds and that contact would be brief.

Produced waters may have an effect on *Sargassum* communities. Water is often a component of the fluid extracted from a well in offshore oil and gas operations. It is more prevalent with oil than with gas extraction. The water is typically separated from the product on a platform and discharged at the sea surface. Produced waters usually have high salinity, high organic carbon, and low dissolved oxygen. They may also contain some added chemicals used in well treatment. These characteristics could make the produced waters toxic to some organisms in the *Sargassum* community, particularly crustaceans and filter feeders (e.g., bryozoa). However, the produced waters are required to meet toxicity limits defined by NPDES permits and would further diffuse through the water mass, reducing concentrations of any toxic component (USEPA, 2004, 2007d, and 2009). The *Sargassum* algae itself has a waxy coating and would be unlikely to be affected by possible short-term exposure.

Platform and service-vessel operational discharges may have an effect on water quality, indirectly affecting *Sargassum* in the immediate area of activity. Since *Sargassum* is ubiquitous in the northern GOM, it would come in contact with operational discharges. However, considering the ratio of the affected area (immediately surrounding the activity) to the entire planning area, and even larger area inhabited by *Sargassum*, it is clear that only a small percent of the total *Sargassum* population would contact operational discharges.

Vessel traffic and the presence of production structures may act as temporary barriers and obstacles for free-floating *Sargassum*. Stationary platforms and their associated fouling communities may snag pelagic *Sargassum* as it passes. In the event that *Sargassum* is caught in the propellers or cooling water intakes of vessels associated with the proposed action, repairable damage may occur to the *Sargassum*.

Further research would enhance our knowledge of the effects, if any, of muds, cuttings, operational discharges, and physical impingement on *Sargassum* and its associated communities. *Sargassum* may have the capacity to absorb chemical substances, which may indirectly affect the health of the *Sargassum* and/or associated organisms. The likelihood that *Sargassum* would contact routine discharges or impinge on ships or stationary platforms is high. However, only a small part of the total population would receive these types of contact, contact would be only for a short time, and concentrations would be low (within permit limits). Given the ratio of *Sargassum* habitat to the surface area of the proposed activities, it may be presumed unlikely that the proposed action would have any lasting effects on *Sargassum* and its associated community.

Summary and Conclusion

Sargassum, as pelagic algae, is a widely distributed resource that is ubiquitous throughout the GOM and northwest Atlantic. Considering its ubiquitous distribution and occurrence in the upper water column near the sea surface, it would be contacted by routine discharges from oil and gas operations. All types of discharges including drill muds and cuttings, produced water, and operational discharges (e.g., deck runoff, bilge water, sanitary effluent, etc.) would contact *Sargassum* algae. However, the quantity and volume of these discharges is relatively small compared with the pelagic waters of the WPA (115,645 km^2 [44,651 mi^2]). Therefore, although discharges would contact *Sargassum*, they would only contact a very small portion of the *Sargassum* population. Likewise, impingement effects by service vessels and working platforms and drillships would contact only a very small portion of the *Sargassum* population. Because these discharges are highly regulated for toxicity and because they would continue to be diluted in the Gulf water, reducing concentrations of any toxic component, produced-water impacts on *Sargassum* would be minimum. The impacts to *Sargassum* that are associated with the proposed action are expected to have only minor effects to a small portion of the *Sargassum* community as a whole. The *Sargassum* community lives in pelagic waters with generally high water quality and would be resilient to the minor effects predicted. It has a yearly cycle that promotes quick recovery from impacts. No measurable impacts are expected to the overall population of the *Sargassum* community.

4.1.1.7.3. Impacts of Accidental Events

Proposed Action Analysis

Impact-producing factors associated with accidental events for the WPA proposed action that could affect *Sargassum* and its associated communities include (1) surface oil and fuel spills and underwater well blowouts, (2) spill-response activities, and (3) chemical spills. These impacting factors would have varied effects depending on the intensity of the spill and the presence of *Sargassum* in the area of the spill.

Oil spills are the major accidental events of concern to the *Sargassum* community. The risk of various sizes of oil spills occurring in the WPA is presented in **Table 3-5**. The possibility of a spill over 10,000 bbl in the OCS of the WPA is estimated to be less than one spill, over the 40-year cycle for the proposed action of the 5-Year Program. Up to two blowouts are estimated to occur in the same period (Table 3-3 of the 2009-2012 Supplemental EIS).

All known reserves in the GOM have specific gravity characteristics that indicate the oil would float to the sea surface. As discussed in Chapter 4.3.1.5.4 of the Multisale EIS, oil discharges that occur at the seafloor from a pipeline or loss of well control would rise in the water column, surfacing almost directly over the source location. Oil on the sea surface has the potential to negatively impact *Sargassum* communities. While components of oil on the sea surface would be removed through evaporation, dissipation, biodegradation, and oil-spill cleanup operations, much of it would persist until it contacts a seashore. Oil at the sea surface can be mixed into the upper water column by wind and wave action to a depth of 10 m (33 ft) (Lange, 1985; McAuliffe et al., 1975 and 1981; Knap et al., 1985). With vigorous wave action, the oil can form an emulsion with water that is viscous and persistent.

When dispersants are applied to oil on the sea surface or at depth, its behavior is modified, causing the oil to mix with water. The dispersed oil would be suspended in the water column and would begin to flocculate with particulate matter until it becomes heavy enough to sink to the seafloor. Oil treated with dispersant at depth would form underwater plumes that would not rise to the sea surface. Oil treated with dispersant on the sea surface would mix with the water where its contact with *Sargassum* may be temporarily increased in the upper few meters of the water column. Data from other studies on dispersant usage on surface plumes indicate that a majority of the dispersed oil remained in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a). As time passes, the oil would begin to adhere to particles in the water column, form clumps, and sink toward the seafloor (ITOPF, 2007; Kingston, 1995).

The effects of oil contact with *Sargassum* communities would vary depending on the severity of exposure. *Sargassum* that contacts concentrated oil that coats the algae would likely succumb to the effects, die, and sink to the seafloor. Any attached organisms would suffer the same fate. Motile organisms that are dependent on the algae for habitat (shrimp, crabs, nudibranchs, snails, *Sargassum* fish, etc.) may also be directly contacted by the oil or may be displaced into open water, resulting in death. *Sargassum* exposed to oil in lower concentrations may suffer sublethal effects. Levels of hydrocarbons, toxins, and chemicals in *Sargassum* from an accidental spill and spill cleanup may be concentrated up to four times that found in the adjacent waters (Burns and Teal, 1973). The effects of concentrated toxins on the macroalgae itself are undefined. It may result in the loss of associated organisms such as attached epifauna that use the algae as a substrate and other organisms that utilize the community as habitat, including sea turtles, juvenile fish, and various invertebrates. Pelagic organisms feeding on the community may suffer sublethal effects that could reduce health and reproduction.

A catastrophic spill could affect a sizable portion of the *Sargassum* population. Since *Sargassum* is ubiquitous in the northern GOM, the portion of the population affected would be similar to the portion of the surface waters affected. For example, if 10 percent of the surface waters of the northern GOM are affected by oil, about 10 percent of the *Sargassum* population at that time may come in contact with oil.

However, a reliable estimate must also consider the annual cycle of *Sargassum* because density of the algae varies with season and across geographic locations. If the large spill occurs in an area of high or low *Sargassum* density, then a correspondingly higher or lower percent of the *Sargassum* population would be affected. Impacts from a catastrophic spill and cleanup effort could destroy a large enough portion of the population to affect subsequent populations in the Atlantic. The *Sargassum* community lives in pelagic waters with generally high water quality and is expected to show good resilience to the predicted effects of spills. It has a yearly cycle that promotes quick recovery from impacts. No measurable impacts are expected to the overall population of the *Sargassum* community unless a catastrophic spill occurs.

Spill-response activities may contribute to negative impacts on *Sargassum*. The number of vessels working to clean a spill can increase physical damage to the *Sargassum* community, especially in the immediate vicinity of the spill. Vessels damage algae by cutting it with their propellers, but impingement in cooling water intake is probably a larger effect. Vessels circulate seawater through shipboard systems as coolant. This can damage *Sargassum* directly; in addition, an anti-foulant such as bleach or copper is typically injected to the water to prevent internal growth of organisms inside the systems. Other response activities, such as skimming oil from the sea surface, can also damage and remove *Sargassum*. However, these impacts may be inconsequential, as a large part of the *Sargassum* affected would already be contacted by oil. Another major response activity that may occur is the spraying of dispersant. Direct effects of dispersant on the *Sargassum* community are unknown, but dispersants are known to be toxic to some invertebrates. The use of dispersants is a trade-off to achieve the least overall damage. For example, dispersants may increase short-term contact of oil with *Sargassum* and may have some inherent toxic properties, but their use can prevent the formation of persistent emulsions and promote diffusion of oil, resulting in biodegradation, clumping, and sinking.

Chemical spills are typically small (a few gallons to a few barrels of product) and are unlikely to produce any measurable impact on *Sargassum* communities. Due to the ubiquitous nature of *Sargassum* over most of the GOM, such spills are negligible to the overall population.

A spill may impact the productivity and longevity of *Sargassum* in an area. A very large spill may produce a measurable effect on the population of *Sargassum* in the Gulf of Mexico, reducing the overall biomass that is flushed into the Atlantic via the Loop Current and Gulf Stream. However, because of the nature of algal growth and the quality of the habitat under normal conditions, a more likely result is that local populations of *Sargassum* are affected that produce short-term measurable effects in the local area with rapid recovery. The *Sargassum* community is widely distributed over a very large area, including two oceans, and appears to have an annual cycle of growth that lends itself to resilient recovery in a short time.

Summary and Conclusion

Sargassum, as pelagic algae, is a widely distributed resource that is ubiquitous throughout the northern GOM and northwest Atlantic. Considering its ubiquitous distribution and occurrence in the upper water column near the sea surface, it would contact potential accidental spills from oil and gas operations. All types of spills, including surface oil and fuel spills, underwater well blowouts, and chemical spills, would contact *Sargassum* algae. The quantity and volume of most of these spills would be relatively small compared with the pelagic waters of the WPA (115,645 km^2 [44,651 mi^2]). Therefore, most spills would only contact a very small portion of the *Sargassum* population. The impacts to *Sargassum* that are associated with the proposed action are expected to have only minor effects to a small portion of the *Sargassum* community unless a catastrophic spill occurs. In the case of a very large spill, the *Sargassum* algae community could suffer severe impacts to a sizable portion of the population in the northern GOM. The *Sargassum* community lives in pelagic waters with generally high water quality and is expected to show good resilience to the predicted effects of spills. It has a yearly cycle that promotes quick recovery from impacts. No measurable impacts are expected to the overall population of the *Sargassum* community unless a catastrophic spill occurs.

4.1.1.7.4. Cumulative Impacts

Pelagic *Sargassum* algae is an unusual habitat found in the GOM and western Atlantic. It is comprised of floating mats of macroalgae that lives on the surface and upper water column of the sea, along with a varied community of organisms that inhabit it. It also supports a transient community of pelagic fish that take refuge and/or forage in the habitat. See **Chapter 4.1.1.7.1** for a description of *Sargassum* habitat. Several impacting factors can affect *Sargassum*, including impingement by structures and marine vessels, oil and gas drilling discharges, operational discharges, accidental spills, hurricanes, and coastal water quality.

Pelagic *Sargassum* floats at the surface in oceanic waters and is carried by surface currents across the GOM. Vessels transiting the Gulf pass through *Sargassum* mats, producing slight impacts to the *Sargassum* community by their passage, some propeller impacts, and possible impingement on cooling water intakes. None of these would have more than minor localized effects to the mats transited. Oil and gas structures can impede the movement of *Sargassum* mats and may entrap small quantities of the algae. This is expected to be a minor impact with no consequences to the overall *Sargassum* community.

Oil and gas drilling results in discharges of drill cuttings with small quantities of associated drilling muds and well treatment chemicals. Most cuttings from well drilling are discharged from the drill platform at the sea surface. This creates an area of high turbidity in the vicinity of drill operations. Small quantities of drill muds adhere to the cuttings that are discharged. Well treatment chemicals accompany muds into the well and may be discharged in small quantities with the cuttings. The composition of muds is strictly regulated, and discharges of cuttings/muds are tested to ensure that toxicity levels are below the limits allowed by NPDES permits (USEPA, 2004, 2007d, and 2009). Cuttings discharged at the sea surface may spread out to 1,000 m (3,280 ft) from the source, depending on currents, with the thickest layers at the well and the majority of the sediment within 250 m (820 ft) (CSA, 2006a; Kennicutt et al., 1996). Fine components of the plume may travel farther but are dispersed in the water column and are distributed widely at low concentrations (CSA, 2004b; NRC, 1983). Contaminants from produced waters are reported in benthic environments up to 1,000 m (3,280 ft) from the source (Peterson et al., 1996; Armstrong et al., 1977; Osenberg et al., 1992). Floating mats of *Sargassum* that pass by a drilling operation would experience short-term exposure to drill cuttings with associated muds and well treatment chemicals. This may cause temporary stress to organisms including changes in respiration rate, abrasion, reduced feeding, reduced water filtration rates, and reduced response to physical stimulus (Anchor Environmental CA, L.P., 2003). These effects would be localized to a small portion of the total *Sargassum* population and represent a negligible amount of the incremental impact to *Sargassum* communities.

Marine vessels of all types produce at least some minor effects to the environment. Oil and gas platforms and drill ships produce similar effects. Runoff water from the decks of ships and platforms may contain small quantities of oil, metals, and other contaminants. Larger vessels and offshore platforms discharge effluents from sanitary facilities (gray water). They also circulate seawater to cool ship's engines, electric generators, and other machines. The cooling water discharge may be up to 11°C (20°F) warmer than the surrounding seawater (USDOT, CG, 2003; Patrick et al., 1993). This temperature difference can accumulate in the vicinity of the discharge. For ships, this would only occur when the vessel is stationary, as in port. For oil and gas platforms and drill ships and for offshore liquid natural gas terminals, localized warming of the water could occur (Emery et al., 1997; USDOT, CG, 2003). However, the warm water is rapidly diluted, mixing to background temperature levels within 100 m (328 ft) of the source (USDOT, CG, 2003). Effects from gray water, deck runoff, and cooling water are only notable for stationary locations. Produced waters from stationary locations are rapidly diluted and impacts are only observed within 100 m (328 ft) of the discharge point (Neff and Sauer, 1991; Trefry et al., 1995; Gittings et al., 1992a). Those effects are very localized, with only brief contact to passing *Sargassum* before dilution to background levels. These effects would comprise a negligible portion of the overall cumulative impact to *Sargassum* communities.

Accidental spills of oil and other chemicals could affect *Sargassum* and its community wherever they contact the algae. Small spills would have a limited local effect on a small portion of the *Sargassum* community. Short-term exposure of passing *Sargassum* to high concentrations of oil and chemicals could result in death and sinking of algae and organisms contacted. The size of the overall effect on *Sargassum* would depend on the size of the spill and the success of spill-response efforts. A catastrophic spill such as the DWH event could have noticeable impacts to the overall *Sargassum* community. These impacts could destroy a sizable portion of *Sargassum* habitat wherever the surface slick of oil travels. The effects could reduce the supply of algae transiting from the GOM to the Atlantic. This effect, although large, would contact only a portion of the algae in the region of the spill. *Sargassum* algae is a widespread habitat with patchy distribution across the northern GOM and the western Atlantic. Due to the vegetative production of *Sargassum* algae, the community would likely recover within 1-2 seasons (1-2 years). The probability of occurrence of a catastrophic spill is very low. If such a spill does occur, it would account for a sizable portion of the cumulative impact that affects *Sargassum*, although even such an impact would affect only a portion of the *Sargassum* in one region of its occurrence.

Hurricanes are major natural impacts that affect the *Sargassum* community. The violent surface turbulence of these storms would dislocate many of the organisms living on and in the *Sargassum*. Some of the organisms (those that cannot swim or swim only weakly) such as nudibranchs (sea slugs), shrimp, sargassumfish (*Histrio histrio*), and pipefish (*Syngnathus* spp.) would become separated from the algae. Without cover, many would fall prey to larger fish after the storm; others may sink to the seafloor and die. Some epifauna, such as hydroids, living on the algae may suffer physical damage or be broken off. In addition, hurricanes drive large quantities of *Sargassum* toward shore, into coastal waters having less conducive conditions for *Sargassum* and even stranding large quantities on shore. Although hurricanes offer major physical damage to *Sargassum* communities, these are natural events for which the *Sargassum* is adapted. The general high quality of the pelagic habitat supports a thriving *Sargassum* algae community that can be expected to maintain high resilience, giving it a strong ability to recover from detrimental impacts. Although hurricanes cause widespread physical damage to the *Sargassum* community seasonally, the habitat routinely recovers from these stresses. Hurricane impacts may be a large part of the cumulative impacts to *Sargassum*, but they are a part of the normal cycle for the community.

Coastal water conditions are normally of lower quality than those found farther offshore in pelagic waters. *Sargassum* mats are often driven toward shore by onshore winds. Some is stranded on coastal barrier islands and beaches. Water quality conditions nearshore are different than the pelagic environment, with much higher turbidity, higher nutrients, and higher levels of contaminants. These conditions can be expected to cause stress to the algae and its inhabitants as they suffer from clogging of gills and filter mechanisms and lower light conditions. Increased coastal urbanization contributes to lower water quality in coastal waters, particularly near the outlets of rivers. This loss of *Sargassum* to shoreward movement is a normal part of community dynamics, although the effects may be exacerbated by increased declines in coastal water quality. As with hurricanes, loss of *Sargassum* to the coastal environment contributes to cumulative impacts for the overall community in the GOM.

A broad Internet search for relevant new information, as well as a search for scientific journal articles, was conducted using a publicly available search engine. In addition, the websites for Federal and State agencies, as well as other organizations were reviewed for newly released information. Sources investigated include the South Atlantic Fishery Management Council, coordinated communications with the Gulf of Mexico Alliance, USEPA, USGS, and coastal universities. Interviews with personnel from academic institutions and governmental resource agencies were conducted to determine the availability of new information. In addition, there are ongoing NOAA- and National Science Foundation-funded research projects that are investigating the *Sargassum* distribution and impacts from the DWH event.

Summary and Conclusion

Because of the ephemeral nature of *Sargassum* communities, many activities associated with the proposed action would have a localized and short-term effect. *Sargassum* occurs seasonally in almost every part of the northern GOM, resulting in a wide distribution over a very large area. However, its occurrence is patchy, drifting in floating mats that are occasionally impinged on ships and on oil and gas structures. The large, scattered, patchy distribution results in only a small portion of the total population contacting ships, structures, or drilling discharges. There is also a low probability of a catastrophic spill to occur with the WPA proposed action. If such a spill did occur, *Sargassum* in that area is expected to suffer mortality. However, *Sargassum* resilience is good and recovery is expected within one or two growing seasons. The incremental contribution of the proposed action to the overall cumulative impacts on *Sargassum* communities that would result from the OCS Program, environmental factors (such as hurricanes and coastal water quality), and non-OCS-related activities (such as non-OCS vessel traffic and commercial shipping) are expected to be minimal.

4.1.1.8. Chemosynthetic Deepwater Benthic Communities

The BOEMRE has reexamined the analysis for chemosynthetic deepwater benthic communities presented in the Multisale EIS and the 2009-2012 Supplemental EIS based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusion for this resource presented in the Multisale EIS and the 2009-2012 Supplemental EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS. A brief summary of potential impacts follows. Chemosynthetic communities are susceptible to physical impacts from structure placement, anchoring, and pipeline installation associated with the WPA proposed action; however, the guidance provided in NTL 2009-G40 greatly reduces the risk of these physical impacts by requiring avoidance of potential chemosynthetic communities and by consequence avoidance of other hard-bottom communities. Even in situations where the substantial burial of typical benthic infaunal communities occurred, recolonization from populations from widespread neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms. Potential accidental events associated with the WPA proposed action are expected to cause little damage to the ecological function or biological productivity of the widespread, low-density chemosynthetic communities and the widespread, typical, deep-sea, soft-bottom communities. The most serious, cumulative, impact-producing factor threatening chemosynthetic communities is physical disturbance of the seafloor by OCS activities, which could destroy the organisms of these communities. The incremental contribution of the proposed action to the cumulative impacts is expected to be slight, and adverse impacts would be limited but not completely eliminated by adherence to NTL 2009-G40.

4.1.1.8.1. Description of the Affected Environment

A detailed description of the continental slope and deepwater resources can be found in Chapter 3.2.2.2 of the Multisale EIS any new information since the publication of the Multisale EIS is presented in Chapter 4.1.5.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the Supplemental EIS, and new information that has become available since both documents were prepared.

Continental Slope and Deepwater Resources

The northern GOM is a geologically complex basin. It has been described as the most complex continental slope region in the world (Carney, 1997 and 1999; Rowe and Kennicutt, 2009). Regional topography of the slope consists of basins, knolls, ridges, and mounds derived from the dynamic adjustments of salt to the introduction of large volumes of sediment over long time scales. This region has become much better known in the last three decades, and the existing information is considerable, both from a geological and biological perspective. The first substantial collections of deep GOM benthos were made during the cruises of the USCG and Geodetic Steamer, *Blake*, between 1877 and 1880. Rowe and Menzel (1971) reported that their deep GOM infauna data were the first quantitative data published for this region. The first major study of the deep northern GOM was performed by a variety of researchers from Texas A&M University between 1964 and 1973 (Pequegnat, 1983). A total of 157 stations were sampled and photographed between depths of 300 and 3,800 m (984 and 12,467 ft) (the deepest part of the GOM). A more recent Agency-funded study was completed by LGL Ecological Research Associates and Texas A&M University in 1988, during which a total of 60 slope stations were sampled throughout the northern GOM in water depths between 300 and 3,000 m (9,842 ft) (Gallaway et al., 1988). As part of this multiyear study, along with trawls and quantitative box-core samples, 48,000 photographic images were collected and a large subset was quantitatively analyzed. Another major study, titled *Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study*, was completed in 2009. This 6-year project spanned three field sampling years and included collections of benthos and sediments through trawling, box coring, and bottom photography at a total of 51 stations ranging in depth from 213 to 3,732 m (699 to 12,244 ft), including some stations in Mexican waters (Rowe and Kennicutt, 2009).

"Deepwater" is a term of convenience referring (in this use) to vast areas of the Gulf with water depths ≥300 m (984 ft) that are typically covered by pelagic clay and silt. In, on, and directly above these sediments live a wide variety of single-celled organisms, invertebrates, and fish. Their lifestyles are extremely varied and can include absorption of dissolved organic material, symbiosis, collection of food through filtering, mucous webs, seizing, or other mechanisms including chemosynthesis. Chemosynthetic communities are a remarkable assemblage of invertebrates found in association with hydrocarbon seeps. The seeps provide a source of carbon independent of photosynthesis and the sun-dependent photosynthetic food chain that supports all other life on earth.

The continental slope is a transitional environment influenced by processes of both the shelf (<200 m; 650 ft) and the abyssal GOM (>975 m; 3,199 ft). This transitional character applies to both the pelagic and the benthic realms. The highest values of surface primary production are found in the upwelling areas in the De Soto Canyon region. In general, the eastern GOM is more productive in the oceanic region than is the western GOM. Nutrients in the system act as fertilizer, producing blooms in phytoplankton (single-celled algae). There is a time lag after each algae bloom as the zooplankton catch up with a corresponding bloom as they feed on the phytoplankton. The zooplankton then egests a high percentage of their food intake as feces that sink toward the bottom and provide nutrients to benthic (seafloor) communities.

Deepwater fauna can be grouped into major assemblages defined by depth, including (1) upper slope, (2) mid-slope, (3) lower slope, and (4) abyssal plain (Rowe and Kennicutt, 2009). (The seven zones [Table 3-3 of the Multisale EIS] previously described by Pequegnat [1983] and confirmed by LGL Ecological Research Associates, Inc. and Texas A&M University [Gallaway et al., 1988] now appear to be too numerous.) The 450-m (1,476-ft) isobath defines the truly deep-sea fauna where the aphotic zone begins at and beyond these depths. In these sunlight-deprived waters, photosynthesis cannot occur and processes of food consumption, biological decomposition, and nutrient regeneration occur in cold and dark waters. The lowermost layer containing the last meter of water above the bottom and the bottom itself constitute the benthic zone. This zone is a repository of sediments where nutrient storage and regeneration take place in association with the solid and semisolid substrate (Pequegnat, 1983).

Similar to the continental slope in general, the proposed WPA lease sale area encompasses a vast range of habitats and water depths. The shallowest portions start nearshore at the boundary of State waters, and the deepest portions extend nearly into the deepest part of the GOM at approximately 3,500 m (11,483 ft) south of the Sigsbee Escarpment in the Central Gulf. This is not particularly deep for the rest of the world's oceans, but it is within a few hundred meters of the deepest point of the GOM at 3,800 m (12,467 ft) and is only accessible from Mexican waters of the southern Gulf. The proposed lease sale area also includes the lower portions of De Soto Canyon, the most notable sea-bottom feature on the upper slope in this area. Its formation has been attributed to a combination of erosion, deposition, and structural control of salt diapirs clustered in the vicinity (Harbison, 1968). Although the northeastern edge of the canyon has a steep slope, unlike most submarine canyons, De Soto Canyon has a comparatively gentle gradient; however, it does have significant impact on current structure, upwelling features, and resulting increases in biological productivity.

A great number of publications have been derived from the two major Agency-funded deep Gulf studies of Gallaway et al. (1988) and Rowe and Kennicutt (2009). These two studies provide extensive background information on deepwater GOM habitat and biological communities.

The vast majority of the Gulf of Mexico seabed is comprised of soft sediments. Major groups of animals that live in this habitat include the following: (1) bacteria and other microbenthos; (2) meiofauna (0.063-0.3 mm); (3) macrofauna (>0.3 mm); and (4) megafauna (larger organisms such as crabs, sea pens, sea cucumbers, crinoids, and bottom-dwelling [demersal] fish). All of these groups are represented throughout the entire Gulf − from the continental shelf to the deepest abyssal depths.

The continental slope and the abyssal zone (≥1,000 m; 3,281 ft) have the following divisions and characteristic faunal assemblages:

- Shelf-Slope Transition Zone (150-450 m; 492-1,476 ft)—A very productive part of the benthic environment. Demersal fish are dominant, many reaching their maximum populations in this zone. Asteroids, gastropods, and polychaetes are common.

- Archibenthal Zone—Horizon A (475-740 m; 1,558-2,428 ft)—The Horizon A Assemblage is located between 475 and 740 m. Although less abundant, the demersal fish are a major constituent of the fauna, as are gastropods and polychaetes. Sea cucumbers are more numerous.
- Archibenthal Zone—Horizon B (775-950 m; 2,543-3,117 ft)—The Horizon B Assemblage, located at 775-950 m, represents a major change in the number of species of demersal fish, asteroids, and echinoids, which reach maximum populations here. Gastropods and polychaetes are still numerous.
- Upper Abyssal Zone (1,000-2,000 m; 3,281-6,562 ft)—Number of fish species decline while the number of invertebrate species appear to increase; sea cucumbers, *Mesothuria lactea* and *Benthodytes sanguinolenta,* are common; galatheid crabs include 12 species of the deep-sea genera *Munida* and *Munidopsis*, while the shallow brachyuran crabs decline.
- Mesoabyssal Zone (2,300-3,000 m; 7,546-9,843 ft)—Fish species are few, and echinoderms continue to dominate the megafauna.
- Lower Abyssal Zone (3,200-3,800 m; 10,499 to 12,468 ft)—Large asteroid, *Dynaster insignis*, is the most common megafaunal species.

Megafauna: Animals of a size typically caught in trawls and large enough to be easily visible (e.g., crabs, shrimp, benthic fish, etc.) are called megafauna. In the Gulf, most are crustaceans, echinoderms, or benthic fish. Benthic megafaunal communities in the deep Gulf appear to be typical of most temperate continental slope assemblages found at depths from 300 to 3,000 m (984 to 9,843 ft) (USDOI, MMS, 2001a, p. 3-63). Exceptions include the chemosynthetic communities. Although soft-bottom fauna are expected to predominate, occasional sea pens, sea whips, and sponges are observed during ROV surveys (Geoscience Earth & Marine Services, Inc., 2005).

Megafaunal invertebrate and benthic fish densities appear to decline with depth between the upper slope and the abyssal plain (Pequegnat 1983; Pequegnat et al., 1990). This phenomenon is generally believed to be related to the low productivity in deep, offshore Gulf waters (USDOI, MMS, 2001a, p. 3-60). Megafaunal communities in the offshore Gulf have historically been zoned by depth (see above), which are typified by certain species assemblages (Menzies et al., 1973; Pequegnat, 1983; Gallaway et al., 1988; Gallaway and Kennicutt, 1988; Pequegnat et al., 1990; USDOI, MMS, 2001a, p. 3-64).

Carney et al. (1983) postulated a simpler system of zonation having three zones: (1) a distinct shelf fauna in the upper 1,000 m (3,281 ft); (2) indistinct slope fauna between 1,000 and 2,000 m (3,281 and 6,562 ft); and (3) a distinct abyssal fauna between 2,000 and 3,000 m (6,562 and 9,843 ft).

The baseline Northern Gulf of Mexico Continental Slope (NGMCS) Study conducted in the mid- to late 1980's trawled 5,751 individual fish and 33,695 invertebrates, representing 153 and 538 taxa, respectively. That study also collected 56,052 photographic observations, which included 76 fish taxa and 193 non-fish taxa. The photographic observations were dominated by sea cucumbers, bivalves, and sea pens, groups that were not sampled effectively (if at all) by trawling. Decapod crustaceans dominated the trawls and were fourth in abundance in photos. Decapod density generally decreased with depth but abundance peaks were determined at 500 m (1,640 ft) and between 1,100 and 1,200 m (3,609 and 3,937 ft), beyond which numbers diminished. Fish density, while variable, was generally high at depths between 300 and 1,200 m (984 and 3,937 ft); it then declined substantially.

Gallaway et al. (2003) concluded that megafaunal composition changes continually with depth such that a distinct upper slope fauna penetrates to depths of about 1,200 m (3,937 ft) and a distinct deep-slope fauna is present below 2,500 m (8,202 ft). A broad transition zone characterized by low abundance and diversity occurs between depths of 1,200 and 2,500 m (3,937 and 8,203 ft).

Macrofauna: The benthic macrofaunal component of the NGMCS Study (Gallaway et al., 2003) included sampling in nearby areas at similar depths, both east and west of the proposed action. The study NGMCS examined 69,933 individual macrofauna from over 1,548 taxa; 1,107 species from 46 major groups were identified (Gallaway et al., 2003). Polychaetes (407 species), mostly deposit-feeding forms (196 taxa), dominated in terms of numbers. Carnivorous polychaetes were more diverse, but less numerous than deposit-feeders, omnivores, or scavengers (Pequegnat et al., 1990; Gallaway et al., 2003). Polychaetes were followed in abundance by nematodes, ostracods, harpacticoid copepods, bivalves, tanaidacids, bryozoans, isopods, amphipods, and others. Overall abundance of macrofauna ranged from 518-5,369 individuals/m^2 (Gallaway et al., 1988). The central transect (4,938 individuals/m^2) had higher macrofaunal abundance than either the eastern or western Gulf transects (4,869 and 3,389 individuals/m^2, respectively) (Gallaway et al., 2003).

In the GOM, macrofaunal density and biomass declines with depth from approximately 5,000 individuals/m^2 on the lower shelf-upper slope to several hundred individuals/m^2 on the abyssal plain (USDOI, MMS, 2001a, p. 3-64). This decline in benthos has been attributed to the relatively low productivity of the Gulf offshore open waters (USDOI, MMS, 2001a, p. 3-60). Pequegnat et al. (1990) reported mid-depth maxima of macrofauna in the upper slope at some locations with high organic particulate matter, and Gallaway et al. (2003) noted that the decline with depth is not clear cut and is somewhat obscured by sampling artifacts. There is some suggestion that the size of individuals decrease with depth (Gallaway et al., 2003).

Meiofauna: Meiofauna primarily composed of small nematode worms, as with megafauna and macrofauna, also decline in abundance with depth (Pequegnat et al., 1990; USDOI, MMS, 2001a, p. 3-64; Gallaway et al., 2003). The overall density (mean of 707,000/m^2) of meiofauna is approximately two orders of magnitude greater than the macrofauna throughout the depth range of the slope (Gallaway et al., 1988). These authors reported 43 major groups of meiofauna with nematodes, harpacticoid copepods (adults and larvae), polychaete worms, ostracods, and kinorhynchs accounting for 98 percent of the total numbers. Nematode worms and harpacticoids were dominant in terms of numbers, but polychaetes and ostracods were dominant in terms of biomass, a feature that was remarkably consistent across all stations, regions, seasons, and years (Gallaway et al., 2003). Meiofaunal densities appeared to be somewhat higher in the spring than in the fall. Meiofaunal densities reported in the NGMCS Study are among the highest recorded worldwide (Gallaway et al., 2003). There is also evidence that the presence of chemosynthetic communities may enrich the density and diversity of meiofauna in the immediate surrounding area (Gallaway et al., 2003).

Microbiota: Less is known about the microbiota in the GOM than the other size groups, especially in deep water (CSA, 2000; USDOI, MMS, 2000, p. IV-15). While direct counts have been coupled with some in situ and repressurized metabolic studies performed in other deep ocean sediments (Deming and Baross, 1993), none have been made in the deep GOM. Cruz-Kaegi (1998) made direct counts using a fluorescing nuclear stain at several depths down the slope, allowing bacterial biomass to be estimated from their densities and sizes. Mean biomass was estimated to be 2.37 g of carbon/m^2 for the shelf and slope combined, and 0.37 g of carbon/m^2 for the abyssal plain. In terms of biomass, data indicate that bacteria are the most important component of the functional infaunal biota. Cruz-Kaegi (1998) developed a carbon cycling budget based on estimates of biomass and metabolic rates in the literature. She discovered that, on the deep slope of the Gulf, the energy from organic carbon in the benthos is cycled through bacteria.

Deepwater Horizon *Event*

The DWH event released an estimated 4.9 million barrels of oil into the water over an 87-day period following the event. Extensive literature, Internet, and database searches have been conducted for results of scientific data. Although many research cruises have occurred, very few scientific results have been published as of this writing. Descriptions of studies completed or in progress are discussed and available results are included. Although the impacts of the oil spill are not yet known, possible impacts to deepwater benthic communities are discussed. These impacts relate mostly to the CPA area, which was directly affected by the DWH event. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of the plumes and visible sheens related to oil from the DWH event extended no farther west than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). As such, it appears that chemosynthetic deepwater benthic communities in the WPA were not affected by the DWH event. Even if oil from the DWH event reached the WPA, it was likely heavily diluted and, thus, significant impacts would not be expected.

As noted above, studies and data are continuing to be developed in response to the DWH event. This information will likely be developed through the NRDA process. It may be years before this information becomes available, and certainly not within the timeframe of this Supplemental EIS process. Although this information may be relevant to reasonably foreseeable adverse effects on chemosynthetic deepwater benthic communities in the WPA, this information remains incomplete or unavailable at this time, regardless of the costs that would otherwise be necessary to obtain this information. What credible scientific information is available was applied using accepted methodologies. Regardless, complete data are not essential to a reasoned choice among alternatives because of the distance of the WPA from the most western extent of the sheen and plumes from the Macondo well (making any impacts extremely remote); the expectation that, if oil from the DWH did reach the WPA, it would have been heavily diluted; and the fact that these communities exist in a dynamic environment in the presence of naturally occurring seeps.

Chemosynthetic Communities

A detailed description of the chemosynthetic communities can be found in Chapter 3.2.2.2.1 of the Multisale EIS and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.5.1.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Chemosynthetic communities are remarkable in that they utilize a carbon source independent of photosynthesis and the sun-dependent photosynthetic food chain that supports all other life on earth. Although the process of chemosynthesis is entirely microbial, chemosynthetic bacteria can support thriving assemblages of higher organisms. This is accomplished through symbiotic relationships in which the chemosynthetic bacteria live within the tissues of tube worms and bivalves and provide a food source for their hosts. The first discovery of deep-sea chemosynthetic communities including higher animals was unexpectedly made at hydrothermal vents in the eastern Pacific Ocean during geological explorations (Corliss et al., 1979). The principal organisms included tube worms, clams, and mussels that derive their entire food supply from symbiotic chemosynthetic bacteria, which obtain their energy needs from chemical compounds in the venting fluids. Similar communities were first discovered in the eastern Gulf of Mexico in 1983 at the bottom of the Florida Escarpment in areas of "cold" brine seepage (Paull et al., 1984). The fauna there was found to be generally similar to vent communities, including tube worms, mussels, and rarely, vesicomyid clams.

Two groups fortuitously discovered chemosynthetic communities in the Gulf of Mexico concurrently in November 1984. During investigations by Texas A&M University to determine the effects of oil seepage on benthic ecology (until this investigation, all effects of oil seepage were assumed to be detrimental), bottom trawls unexpectedly recovered extensive collections of chemosynthetic organisms including tube worms and clams (Kennicutt et al., 1985). At the same time, LGL Ecological Research Associates was conducting a research cruise as part of the Agency-funded, multiyear Northern Gulf of Mexico Continental Slope Study (LGL Ecological Research Associates, Inc. and Texas A&M University, 1986). Bottom photography resulted in clear images of vesicomyid clam chemosynthetic communities. Photography during the same LGL cruise also documented tube-worm communities in situ in the Gulf of Mexico for the first time (Boland, 1986) prior to the initial submersible investigations and firsthand descriptions of Bush Hill in 1986 (Rosman et al., 1987; MacDonald et al., 1989).

Distribution

There is a clear relationship between known hydrocarbon discoveries at great depth in the Gulf slope and chemosynthetic communities, hydrocarbon seepage, and authigenic minerals, including carbonates at the seafloor (Sassen et al., 1993a and 1993b). While the hydrocarbon reservoirs are broad areas several kilometers beneath the Gulf, chemosynthetic communities occur in isolated areas with thin veneers of sediment only a few meters thick.

The northern Gulf of Mexico slope includes a stratigraphic section more than 10 km (6 mi) thick that has been profoundly influenced by salt movement. Mesozoic source rocks from Upper Jurassic to Upper Cretaceous generate oil in most of the Gulf slope fields (Sassen et al., 1993a and 1993b). Migration conduits supply fresh hydrocarbon materials through a vertical scale of 6-8 km (4-5 mi) toward the surface. The surface expressions of hydrocarbon migration are referred to as seeps. Geological evidence demonstrates that hydrocarbon and brine seepage persists in spatially discrete areas for thousands of years. The time scale for oil and gas migration (combination of buoyancy and pressure) from source systems is on the scale of millions of years (Sassen, 1998). Seepage from hydrocarbon sources through faults towards the surface tends to be diffused through the overlying sediment, carbonate outcroppings, and hydrate deposits so the corresponding hydrocarbon seep communities tend to be larger (a few hundred meters wide) than chemosynthetic communities found around the hydrothermal vents of the Eastern Pacific (MacDonald, 1992). There are large differences in the concentrations of hydrocarbons at seep sites.

The widespread nature of Gulf of Mexico chemosynthetic communities was first documented during contracted investigations by the Geological and Environmental Research Group (GERG) of Texas A&M University for the Offshore Operators Committee (Brooks et al., 1986). The occurrence of chemosynthetic organisms dependent on hydrocarbon seepage has been documented in water depths as shallow as 290 m (951 ft) (Roberts et al., 1990) and as deep as 2,200 m (7,218 ft) (MacDonald, 1992). This depth range specifically places chemosynthetic communities in the deepwater region of the Gulf of Mexico, which is defined as water depths greater than 300 m (984 ft). Chemosynthetic communities are not found on the continental shelf. At least 69 communities are now known to exist in the Gulf (**Figure 4-5**). Although a systematic survey has not been done to identify all chemosynthetic communities in the Gulf, there is evidence indicating that many more such communities may exist. The depth limits of discoveries probably reflect the limits of exploration (lack of submersibles capable of depths over 1,000 m [3,281 ft]). MacDonald et al. (1993 and 1996) have analyzed remote-sensing images from space that reveal the presence of oil slicks across the north-central Gulf of Mexico. Results confirmed extensive natural oil seepage in the Gulf, especially in water depths greater than 1,000 m (3,281 ft). A total of 58 additional potential locations were documented where seafloor sources were capable of producing perennial oil slicks (MacDonald et al., 1996). Estimated seepage rates ranged from 4 to 70 bbl/day compared with less than 0.1 bbl/day for ship discharges (both normalized for 1,000 mi^2 [3,430 km^2]). This evidence considerably increases the area where chemosynthetic communities dependent on hydrocarbon seepage may be expected.

The densest aggregations of chemosynthetic organisms have been found at water depths of around 500 m (1,640 ft) and deeper. The best known of these communities was named Bush Hill by the investigators who first described it (MacDonald et al., 1989). It is a surprisingly large and dense community of chemosynthetic tube worms and mussels at a site of natural petroleum and gas seepage over a salt diapir in Green Canyon Block 185. The seep site is a small knoll that rises about 40 m (131 ft) above the surrounding seafloor in water about 580 m (1,903 ft) deep.

Stability

According to Sassen (1998), the role of naturally occurring methane hydrates at chemosynthetic communities has been greatly underestimated. Gas hydrates are a unique and poorly understood class of chemical substances in which molecules of one material (in this case water in solid state—ice) form an open lattice that physically encloses molecules of a certain size (in this case ─ methane) in a cage-like structure without chemical bonding. The biological alteration of frozen gas hydrates was first discovered during the recent Agency-funded study *Stability and Change in Gulf of Mexico Chemosynthetic Communities* (Sager, 1997). It is hypothesized that the dynamics of hydrate alteration could play a major role as a mechanism for the regulation of the release of hydrocarbon gases to fuel biogeochemical processes and could also play a substantial role in community stability (MacDonald, 1998). Recorded bottom-water temperature excursions of several degrees in some areas such as the Bush Hill site (4-5 °C [39-41 °F] at 500-m [1,640-ft] depth) are believed to result in dissociation of hydrates, resulting in an increase in gas fluxes (MacDonald et al., 1994). Although not as destructive as the volcanism at vent sites of the mid-ocean ridges, the dynamics of shallow hydrate formation and movement clearly affects sessile animals that form part of the seepage barrier. There is the potential for an entire layer of shallow hydrate to break free of the bottom and result in considerable impact to local communities of chemosynthetic fauna. At deeper depths (>1,000 m; >3,281 ft), the bottom-water temperature is colder (by approximately 3 °C [37 °F]) and undergoes less fluctuation. The formation of more stable and probably deeper hydrates influences the flux of light hydrocarbon gases to the surface, thus influencing the surface morphology and characteristics of chemosynthetic communities.

Powell (1995) reported on the notable uniqueness of each chemosynthetic community site. Through taphonomic studies (death assemblages of shells) and interpretation of seep assemblage composition from cores, Powell (1995) reported that, overall, seep communities were persistent over periods of 500-1,000 years. Some sites retained optimal habitat over geological time scales. Powell reported evidence of mussel and clam communities persisting in the same sites for 500-4,000 years. Powell also found that both the composition of species and trophic tiering of hydrocarbon seep communities tend to be fairly constant across time, with temporal variations only in numerical abundance. He found few cases in which the community type changed (from mussel to clam communities, for example) or had disappeared completely. Faunal succession was not observed. Surprisingly, when recovery occurred after a past destructive event, the same chemosynthetic species reoccupied a site. There was little evidence of catastrophic burial events, but two such instances were found in mussel communities in Green Canyon Block 234.

Precipitation of authigenic carbonates and other geologic events would undoubtedly alter surface seepage patterns over periods of 1-2 years; although through direct observation, no changes in chemosynthetic fauna distribution or composition were observed at seven separate study sites (MacDonald et al., 1995). A slightly longer period (12 years) can be referenced in the case of Bush Hill, the first community described in situ in 1986. No mass die-offs or large-scale shifts in faunal composition have been observed over the 12-year history of research at this site.

Biology

MacDonald et al. (1990) has described four general community types. These are communities dominated by Vestimentiferan tube worms (*Lamellibrachia c.f. brahma* and *Escarped* sp.), mytilid mussels (Seep Mytilid IA, I, and III, and others), vesicomyid clams (*Vesicomya cordata* and *Calyptogena ponderosa*), and infaunal lucinid or thyasirid clams (*Lucinoma* sp. or *Thyasira* sp.). These faunal groups tend to display distinctive characteristics in terms of how they aggregate, the size of aggregations, the geological and chemical properties of the habitats in which they occur and, to some degree, the heterotrophic fauna that occur with them. Many of the species found at these cold seep communities in the Gulf are new to science and remain undescribed. As an example, at least six different species of seep mussels have been collected, but none is yet described.

Individual lamellibrachid tube worms, the longer of two taxa found at seeps (the other is an *Escarpia*-like species but probably a new genus), can reach lengths of 3 m (10 ft) and live hundreds of years (Fisher et al., 1997). Growth rates determined from recovered marked tube worms have been variable, ranging from no growth of 13 individuals measured one year to a maximum growth of 20 mm/yr (0.8 in/yr) in a *Lamellibrachia* individual. Average growth rate was 2.5 mm/yr (0.1 in/yr) for the *Escarpia*-like species and 7.1 mm/yr (0.28 in/yr) for lamellibrachids. These are slower growth rates than those of their hydrothermal vent relatives, but *Lamellibrachia* individuals can reach lengths 2-3 times that of the largest known hydrothermal vent species. Lamellibrachid tube worms over 3 m (10 ft) long have been collected on several occasions. Tube worms of this length are probably over 400 years old (Fisher, 1995). Vestimentiferan tube worm spawning is not seasonal and recruitment is episodic.

Growth rates for methanotrophic mussels at cold seep sites have been reported (Fisher, 1995). General growth rates were found to be relatively high. Adult mussel growth rates were similar to mussels from a littoral environment at similar temperatures. Fisher also found that juvenile mussels at hydrocarbon seeps initially grow rapidly, but the growth rate drops markedly in adults; they grow to reproductive size very quickly. Both individuals and communities appear to be very long lived. These methane-dependent mussels have strict chemical requirements that tie them to areas of the most active seepage in the Gulf of Mexico. As a result of their rapid growth rates, mussel recolonization of a disturbed seep site could occur relatively rapidly. There is some early evidence that mussels also have some requirement of a hard substrate and could increase in numbers if suitable substrate is increased on the seafloor (Fisher, 1995).

Unlike mussel beds, chemosynthetic clam beds may persist as a visual surface phenomenon for an extended period without input of new living individuals because of low dissolution rates and low sedimentation rates. Most clam beds investigated by Powell (1995) were inactive, with little sign of growth. Living individuals were rarely encountered. Powell reported that, over a 50-year time span, local extinctions and recolonization should be gradual and exceedingly rare.

Extensive mats of free-living bacteria are also evident at hydrocarbon seep sites. These bacteria may compete with the major fauna for sulfide and methane energy sources and may also contribute substantially to overall production (MacDonald, 1998). The white, nonpigmented mats were found to be an autotrophic sulfur bacteria *Beggiatoa* species, and the orange mats possessed an unidentified nonchemosynthetic metabolism (MacDonald, 1998).

Preliminary information has been presented by Carney (1993) concerning the nonchemosynthetic animals (heterotrophs) found in the vicinity of hydrocarbon seeps. Heterotrophic species at seep sites are a mixture of species unique to seeps (particularly molluscs and crustacean invertebrates) and those that are a normal component from the surrounding environment. Carney reports a potential imbalance that could occur as a result of chronic disruption. Because of sporadic recruitment patterns, predators could gain an advantage, resulting in exterminations in local populations of mussel beds.

Detection

Chemosynthetic communities cannot be reliably detected directly using geophysical techniques; however, hydrocarbon seeps and chemosynthetic communities living on them modify the near-surface geological characteristics in ways that can be remotely detected. These known sediment modifications include the following: (1) precipitation of authigenic carbonate in the form of micronodules, nodules, or rock masses; (2) formation of gas hydrates; (3) modification of sediment composition through concentration of hard chemosynthetic organism remains (such as shell fragments and layers); (4) formation of interstitial gas bubbles or hydrocarbons; and (5) formation of depressions or pockmarks by gas expulsion. These features give rise to acoustic effects such as wipeout zones (no echoes), hard bottoms (strongly reflective echoes), bright spots (reflection enhanced layers), or reverberant layers (Behrens, 1988; Roberts and Neurauter, 1990). Potential locations for most types of communities can be determined by careful interpretation of these various geophysical modifications, but to date, the process remains imperfect and confirmation of living communities requires direct visual techniques.

As part of the Agency-funded study, *Stability and Change in Gulf of Mexico Chemosynthetic Communities*, Sager (1997) characterized the geophysical responses of seep areas that support chemosynthetic communities so that a protocol has been refined to use geophysical remote-sensing techniques to locate chemosynthetic communities reliably. One objective is to use geophysical mapping techniques to reduce the seafloor area that may require searching by much slower and expensive near-bottom techniques.

4.1.1.8.2. Impacts of Routine Events

Background/Introduction

A detailed description of the possible impacts from routine activities associated with the WPA proposed action on chemosynthetic communities is presented in Chapter 4.2.1.1.4.2.1 of the Multisale EIS and in Chapter 4.1.5.2.1 of the 2009-2012 Supplemental EIS.

Chemosynthetic communities are susceptible to physical impacts from drilling discharges, structure placement (including templates or subsea completions), anchoring, and pipeline installation. In deep water as opposed to shallower areas on the continental shelf, discharges of drilling fluids and cuttings at the sea surface are spread across broad areas of the seafloor and are generally distributed in thinner accumulations. The physical disturbances by structures themselves are typically limited to anchors for holding floating drilling or production facilities over the well sites. Anchors from support boats and ships (or any buoys set out to moor vessels), floating drilling units, barges used for construction of platform structures, pipelaying vessels, and pipeline repair vessels also cause disturbances to small areas of the seafloor. Normal pipelaying activities in deep water could impact areas of chemosynthetic organisms if the pipeline crossed the organisms (pipeline burial is not required at depths where chemosynthetic communities are found).

The policies described in NTL 2009-G40 greatly reduce the risk of these physical impacts by requiring avoidance of potential chemosynthetic communities identified on required geophysical survey records or by requiring photodocumentation to establish the absence of chemosynthetic communities prior to approval of the structure or pipeline emplacement.

Proposed Action Analysis

Chemosynthetic communities could be found in the deeper water areas of the WPA (i.e., Subareas W200-400, W400-800, W800-1600, W1600-2400, and W>2400 m). The levels of projected activity in deep water as a result of the WPA proposed action are shown in **Table 3-2**. There are 5-8 production structures estimated to be installed during the 40-year analysis period in the deepwater (>200 m; 656 ft) portions of the WPA as a result of the proposed action. These range from small subsea developments to large developments involving floating, fixed, or subsea structures.

The NTL 2009-G40 describes BOEMRE's policy to search for and avoid dense chemosynthetic communities or areas that have a high potential for supporting these community types, as interpreted from geophysical records. The policies clarified in the NTL guidelines are exercised on all applicable leases and are not optional protective measures. The discussion of the effectiveness of the NTL are presented in Chapter 4.2.1.1.4.2.1 of the Multisale EIS and in Chapter 4.1.5.2.1 in the 2009-2012 Supplemental EIS. Previous NTL 2000-G20 is superseded by NTL 2009-G40; the newer NTL applies to waters as shallow as 300 m (984 ft), and revises the avoidance distance for muds and cuttings discharge to 610 m (2,000 ft) from a potential high-density community.

Summary and Conclusion

Chemosynthetic communities are susceptible to physical impacts from structure placement (including templates or subsea completions), anchoring, and pipeline installation. Without mitigation measures, these activities could result in smothering by the suspension of sediments or the crushing of organisms residing in these communities. Because of the policies described in NTL 2009-G40, the risk of these physical impacts are greatly reduced by requiring the avoidance of potential chemosynthetic communities. Information included in required hazards surveys for oil and gas activities depicts areas that could potentially harbor chemosynthetic communities. This allows BOEMRE to require avoidance of any areas that are conducive to chemosynthetic growth.

The BOEMRE has reexamined the analysis for impacts to chemosynthetic communities presented in the Multisale EIS and in the 2009-2012 Supplemental EIS, based on the additional information presented above. No substantial new information was found that would alter the overall conclusion that impacts on chemosynthetic communities from routine activities associated with the WPA proposed action would be minimal to none.

4.1.1.8.3. Impacts of Accidental Events

Background/Introduction

A detailed description of accidental impacts upon chemosynthetic benthic communities can be found in Chapter 4.4.4.2.1 of the Multisale EIS and in Chapter 4.1.5.3.1 of the 2009-2012 Supplemental EIS. The following is a summary of that information with consideration of new information found since publication of the Multisale EIS and the 2009-2012 Supplemental EIS.

Accidental events that could impact chemosynthetic communities are primarily limited to seafloor blowouts. Surface oil and chemical spills are not considered to be a potential source of measurable impacts on chemosynthetic communities because of the water depths at which these communities are located. A blowout at the seafloor could create a crater and could resuspend and disperse large quantities of bottom sediments within a 300-m (984-ft) radius from the blowout site. This buries organisms located within that distance to some degree. The application of avoidance criteria for chemosynthetic communities recommended by NTL 2009-G40 precludes the placement of a well within 610 m (2,000 ft) of any suspected site of a chemosynthetic community.

All known reserves in the Gulf of Mexico have specific gravity characteristics that would preclude oil from sinking immediately after release at a blowout site. As discussed in Chapter 4.3.1.5.4 of the Multisale EIS, oil discharges that occur at the seafloor from a pipeline or loss of well control would rise in the water column and surface almost directly over the source location, thus not impacting sensitive deepwater communities. Therefore, the oil is expected to rise to the sea surface under natural conditions. This behavior is modified when dispersants are applied to the oil on the sea surface or at depth, causing the oil to mix with water. The dispersed oil then begins to biodegrade and may flocculate with particulate matter in the water column, promoting sinking of the particles. The potential for weathered components from a surface slick, not treated with dispersants, to reach a deepwater community in any measurable volume would be very small.

Studies indicate that periods as long as hundreds of years are required to reestablish a chemosynthetic seep community once it has disappeared (depending on the community type); although it may reappear relatively quickly once the process begins, as in the case of a mussel community. Tube-worm communities may be the most sensitive of all communities because of the combined requirements of hard substrate and active hydrocarbon seepage. Mature tube-worm bushes have been found to be several hundred years old. There is evidence that substantial impacts on these communities could permanently prevent reestablishment, particularly if hard substrate required for recolonization was buried.

Proposed Action Analysis

For water depths >300 m (984 ft), 29-37 blowouts are estimated for the WPA proposed action over the 2007-2046 period (Table 4-5 of the Multisale EIS). The application of avoidance criteria for chemosynthetic communities recommended by NTL 2009-G40 should preclude any impact from a blowout at a minimum distance of 610 m (2,000 ft), which is beyond the distance of expected benthic disturbance. Resuspended bottom sediments transported by near-bottom currents could reach chemosynthetic communities located beyond 610 m (2,000 ft) and potentially impact them by burial or smothering. Oil treated with dispersant on the sea surface or at depth can mix with the water column and be carried by currents to contact chemosynthetic communities.

The risk of various sizes of oil spills occurring in the WPA is presented in **Table 3-5**. The possibility of a spill >10,000 bbl in the WPA is estimated to be less than one spill in the 40-year period for the proposed action. The possibility of oil from a surface spill reaching a depth of 300 m (984 ft) or greater in any measurable concentration is very small. A catastrophic spill, like the DWH event, could affect chemosynthetic community habitat if dispersants are applied on the sea surface or at depth. The dispersed oil would be suspended in the water column and would begin to flocculate with particulate matter until it becomes heavy enough to sink and contact the seafloor. Since oil plumes would be carried by underwater currents, the impacts would be distributed in a line from the source toward the direction that the water currents travel. Oil plumes reaching chemosynthetic communities could cause oiling of organisms, resulting in the death of entire populations on localized sensitive habitats. These potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. Habitats directly in the path of the oil plume when the oil contacts the seafloor would be affected. In addition, sublethal effects are possible for communities that receive a lower level of impact. These effects could include temporary lack of feeding, expenditure of energy to remove the oil, loss of gametes and reproductive delays, loss of tissue mass, and similar effects.

Summary and Conclusion

Chemosynthetic communities could be susceptible to physical impacts from a blowout depending on bottom-current conditions. The guidance provided in NTL 2009-G40 greatly reduces the risk of these physical impacts. It clarifies the requirement to avoid potential chemosynthetic communities identified on the required geophysical survey records or photodocumentation to establish the absence of chemosynthetic communities prior to approval of the structure emplacement. The 2,000-ft (610-m) avoidance required would protect sensitive communities from heavy sedimentation, with only light sediment components able to reach the communities in small quantities.

Studies indicate that periods as long as hundreds of years are required to reestablish a seep community once it has disappeared (depending on the community type). There is evidence that substantial impacts on these communities could permanently prevent reestablishment, particularly if hard substrate required for recolonization was buried by resuspended sediments from a blowout.

Potential accidental impacts from the WPA proposed action are expected to cause little damage to the ecological function or biological productivity of widespread, low-density chemosynthetic communities. The rarer, widely scattered, high-density, Bush Hill-type chemosynthetic communities located at more than 610 m (2,000 ft) away from a blowout could experience minor impacts from resuspended sediments. However, the possibility of oil from a surface spill reaching a depth of 300 m (984 ft) or greater in any measurable concentration is very small. If dispersants are applied to an oil spill, oil would mix into the water column, be carried by underwater currents, and eventually contact the seafloor where it may impact patches of chemosynthetic community habitat in its path.

The BOEMRE has reexamined the analysis for impacts to chemosynthetic communities presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented above. No substantial new information was found to indicate that accidental impacts associated with the WPA proposed action would result in more than minimal impacts to chemosynthetic communities because of the NTL 2009-G40 guidelines. One exception would be in the case of a catastrophic spill combined with the application of dispersant, producing the potential to cause devastating effects on local patches of habitat in the path of subsea plumes where they contact the seafloor. If such an event were to occur, it could take hundreds of years to reestablish the chemosynthetic community in that location.

4.1.1.8.4. Cumulative Impacts

Background/Introduction

A detailed description of cumulative impacts upon deepwater benthic communities of the WPA can be found in Chapter 4.5.4.2 of the Multisale EIS and in Chapter 4.1.5.4 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Cumulative factors considered to impact the deepwater benthic communities of the Gulf of Mexico include both oil- and gas-related and non-oil- and non-gas-related activities. The latter type of impacting factors includes activities such as fishing and trawling at a relatively small scale, and large-scale factors such as storm impacts and climate change.

There are essentially only three fish (or “shellfish”) species considered important to deepwater commercial bottom fisheries—the yellowedge grouper, tilefish, and royal red shrimp. Each of these is discussed in Chapter 4.5.4.2 of the Multisale EIS. Unlike other areas in the Atlantic and in Europe, bottom fishing and trawling efforts in the deeper water of the WPA are currently minimal, and impacts to deepwater benthic communities are negligible.

Other regional non-oil- and non-gas-related sources of cumulative impact to deepwater benthic communities would be possible, but they are considered unlikely to occur. Essentially no anchoring from non-OCS-related activities occurs at the deeper water depths considered for these resources (>300 m; 984 ft). Some impacts are highly unlikely yet not impossible, such as the sinking of a ship or barge resulting in collision or contaminant release directly on top of a sensitive, high-density chemosynthetic community.

The greatest potential for cumulative adverse impacts to occur to the deepwater benthic communities would come from those OCS-related, bottom-disturbing activities associated with pipeline and platform emplacement (including templates and subsea completions), associated anchoring activities, discharges of muds and cuttings, and seafloor blowout accidents. The potential impacts to deepwater benthic communities from these activities were discussed in detail in Chapter 4.5.4.2 of the Multisale EIS.

As exploration and development continue on the Federal OCS, activities have moved farther into the deeper water areas of the Gulf of Mexico. With this trend comes the certainty that increased development would occur on discoveries throughout the entire depth range of the WPA; these activities would be accompanied by limited unavoidable impacts to the soft-bottom deepwater benthos from bottom disturbances and disruption of the seafloor from associated activities. The extent of these disturbances would be determined by the intensity of development in these deepwater regions, the types of structures and mooring systems used, and the effective application of the avoidance criteria as described in NTL 2009-G40 (USDOI, MMS, 2009c). All activity levels for the cumulative scenario in the WPA are shown in Table 4-5 of the Multisale EIS. For the WPA deepwater offshore Subareas W200-400, W400-800, W800-1600, W1600-2400, and W>2400, there are currently an estimated 14-23 exploration and delineation wells and 68-118 development wells to be drilled and 5-8 production structures to be installed through the 40-year analysis period (**Table 3-2**).

Routine discharges of drilling muds and cuttings have been documented to reach the seafloor in water depths >300 m (984 ft), and the impacts have been analyzed in the Multisale EIS, including the results from a study by CSA (2006b), *Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico*. Potential local cumulative impacts could result from accumulations of muds and cuttings resulting from consistent hydrographic conditions and drilling of multiple wells from the same location, causing concentrations of material in a single direction or "splay." It is not expected that detectable levels of muds and cuttings discharges from separate developments or from adjacent lease blocks would act as a cumulative impact to deepwater benthic communities due their physical separation and great water depths.

Numerous new chemosynthetic communities were discovered and explored using the submersible *Alvin* in 2006 and with the remotely operated vehicle *Jason II* in 2007 as part of the recent Agency-funded study, *Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico: Interim Report 2* (Brooks et al., 2009). These new communities were targeted using the same procedures integral to the biological review process and the NTL 2009-G40's recommendations that target areas of potential community areas to be avoided by impacting oil and gas activities.

A blowout at the seafloor could resuspend large quantities of bottom sediments and even create a large crater, destroying any organisms in the area. Structure removals and other bottom-disturbing activities could resuspend bottom sediments, but not at magnitudes as great as blowout events. Subsea structure removals are not expected in water depths >800 m (2,625 ft), in accordance with 30 CFR 250. The distance of separation provided by adherence to the guidelines of NTL 2009-G40 would protect chemosynthetic communities from sedimentation effects of deepwater blowouts. It is reported that chemically dispersed surface oil from the DWH event remained in the top 6 m (20 ft) of the water column, where it mixed with surrounding waters and biodegraded (Lubchenco et al., 2010). Data from other studies on dispersant usage on surface plumes indicate that a majority of the dispersed oil remained in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a). Therefore, oil spills on the sea surface are expected to have little to no effect on deepwater communities.

Subsea oil plumes resulting from a seafloor blowout could affect sensitive deepwater communities. This is especially true if dispersants are applied at depth. A recent report documents damage to a deepwater coral community in an area that oil plume models predicted as the direction of travel for subsea oil plumes from the DWH event. Results are still pending but it appears that a coral community about 15 m x 40 m (50 ft x 130 ft) in size was severely damaged, possibly the result of oil impacts (USDOI, BOEMRE, 2010j). Such blowouts are rare and may not release catastrophic quantities of oil. Oil that is released would be carried in whatever direction the water currents flow. This directional flow could only affect seafloor habitats that are downstream from the source. Sensitive deepwater communities appear to be widely scattered and not as rare as previously expected. Recent BOEMRE analyses of seafloor remote-sensing data indicate over 15,000 locations in the deep GOM that represent potential hard-bottom habitats. While it is likely that any subsea oil plume traveling more than a few miles on the deep seafloor would encounter at least one of these potential habitats, it would result in a localized effect that is not expected to alter the wider population of the GOM.

In cases where high-density communities are subjected to greatly dispersed cumulative discharges or suspended sediments, the impacts are most likely to be sublethal in nature and limited in areal extent. The impacts to ecological function of high-density communities would be minor; minor impacts to ecological relationships with the surrounding benthos would also be likely.

Because of the great water depths, treated sanitary wastes and produced waters are not expected to have any adverse cumulative impacts to any deepwater benthic communities. These effluents would undergo a great deal of dilution and dispersion before reaching the bottom, if ever.

Oil and chemical spills (potentially from non-OCS-related activities) are not considered to be a potential source of measurable impacts on any deepwater communities because of water depth. Oil spills from the surface would tend to float. Oil discharges at depth or on the bottom would tend to rise in the water column and similarly not impact the benthos unless dispersants are applied at depth.

Deepwater coral and other hard-bottom communities not associated with chemosynthetic communities are also expected to be protected from cumulative impacts by general adherence to guidance described in NTL 2009-G40 and the shallow hazards NTL 2008-G05 due to the avoidance of areas represented as hard bottom on surface anomaly maps derived from 3D seismic records (USDOI, MMS, 2008c and 2009c). Biological reviews are performed on all deepwater plans (exploration and production) and pipeline applications, which include an analysis of maps and the avoidance of hard-bottom areas that are also one of several important indicators for the potential presence of chemosynthetic communities.

Summary and Conclusion

Cumulative impacts to deepwater communities in the Gulf of Mexico from sources other than OCS activities are considered negligible. The most serious, impact-producing factor threatening chemosynthetic communities is physical disturbance of the seafloor, which could destroy the organisms of these communities. Such disturbance would most likely come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Drilling discharges and resuspended sediments have a potential to cause minor, mostly sublethal impacts to chemosynthetic communities, but substantial accumulations could result in more serious impacts. Seafloor disturbance is considered to be a threat only to the high-density communities; widely distributed low-density communities would not be at risk. Possible catastrophic oil spills due to seafloor blowouts have the potential to devastate localized deepwater benthic habitats. However, these events are rare and would only affect a small portion of the sensitive benthic habitat in the GOM. Recent analyses reveal over 15,000 possible hard-bottom locations across the deepwater GOM. Guidance provided in NTL 2009-G40 describes required surveys and avoidance prior to drilling or pipeline installation and will greatly reduce risk. New studies have refined predictive information and confirmed the effectiveness of these provisions throughout all depth ranges of the Gulf of Mexico (Brooks et al., 2009). With the dramatic success of this project, confidence is increasing regarding the use of geophysical signatures for the prediction of chemosynthetic communities.

Activities unrelated to the OCS Program include fishing and trawling. Because of the water depths in these areas (>300 m; 984 ft) and the low density of potentially commercially valuable fishery species, these activities are not expected to impact deepwater benthic comminutes. Regionwide and even global impacts from CO_2 build-up and proposed methods to sequester carbon in the deep sea (e.g., ocean fertilization) are not expected to have major impacts to deepwater habitats in the near future. More distant scenarios could include severe impacts.

The proposed activities in the WPA considered under the cumulative scenario are expected to cause little damage to the ecological function or biological productivity of the widespread, low-density chemosynthetic communities. The rarer, widely scattered, high-density, Bush Hill-type chemosynthetic communities could experience isolated minor impacts from drilling discharges or resuspended sediments, with recovery expected within several years, but even minor impacts are not expected. Major impacts to localized benthic habitat are possible in the event of a catastrophic blowout on the seafloor. If physical disturbance (such as anchor damage) or extensive burial by muds and cuttings were to occur to high-density, Bush Hill-type communities, impacts could be severe, with recovery time as long as 200 years for mature tube-worm communities. There is evidence that substantial impacts on these communities would permanently prevent reestablishment. The severity of such an impact is such that there would be incremental losses of productivity, reproduction, community relationships, overall ecological functions of the community, and incremental damage to ecological relationships with the surrounding benthos.

Although OCS activities are the primary impact-producing factors for these communities, the incremental contribution of the WPA proposed action to cumulative impacts is expected to be minimal. The BOEMRE’s protective measures would minimize the possible impacts caused by physical disturbance of the seafloor and minor impacts from sediment resuspension or drill cutting discharges, through avoidance. Adverse impacts will be limited but not completely eliminated by adherence to guidelines in NTL 2009-G40.

4.1.1.9. Nonchemosynthetic Deepwater Benthic Communities

4.1.1.9.1. Description of the Affected Environment

A description of the continental slope and deepwater resources can be found in the introduction to chemosynthetic communities in **Chapter 4.1.1.8** of this Supplemental EIS and in Chapter 3.2.2.2 of the Multisale EIS. Any new information since the publication of the Multisale EIS can be found in Chapter 4.1.5.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Deepwater Coral Benthic Communities

Deepwater corals are relatively rare examples of deepwater communities that would not be expected considering the fact that the vast majority of the deep GOM continental slope is made up of soft silt and clay sediments. Hermatypic (reef-building) corals contain photosynthetic algae and cannot live in deepwater environments; however, many ahermatypic corals can live on suitable substrates (hardgrounds) in these environments. Scleractinian corals are recognized in deepwater habitats, but there is little information regarding their distribution or abundance in the Gulf (USDOI, MMS, 2000, p. IV-14). Scleractinian corals may occupy isolated hard-bottom habitats but usually occur in association with high-density chemosynthetic communities that often are situated on carbonate hardgrounds.

Deepwater coral communities are now known to occur in many locations in the deep GOM (>300 m; 984 ft); one example is represented by what was reported as a deepwater coral reef by Moore and Bullis (1960). In an area measuring 300 m (984 ft) in length and more than 20 nmi (23 mi; 37 km) from the nearest known chemosynthetic community (likely in Viosca Knoll Block 906), a 1955 trawl collection from a depth of 421-512 m (1,381-1,680 ft) retrieved more than 300 lb (136 kg) of the scleractinian coral *Lophelia pertusa*.

The "rediscovery" of the Moore and Bullis site was notable. Prior to a *NR 1* Navy submersible cruise in 2002, there was a need to identify potential study sites for deepwater corals. The location sampled by Moore and Bullis had not been revisited since their trawl in 1955. The rough location given in their paper (29°5' N. latitude, 88°19' W. longitude; Moore and Bullis, 1960) was located in a soft-bottom environment. A biologist with BOEMRE used this location as a starting point and utilized the BOEMRE in-house 3D seismic database depicting seafloor bathymetry and hard-bottom features in the region. Approximately 5 nmi (6 mi; 9 km) to the west of the published location, there was a striking set of features, including a narrow canyon that closely matched the fathometer tracing and depth of a feature illustrated in Moore and Bullis (1960). A number of potential high-reflectivity target locations across the canyon were provided for the *NR 1* project. Although no *Lophelia* coral was found in the canyon, a spectacular habitat including *Lophelia* and a variety of antipatharian "black corals" (some up to 3 m [9.8 ft] in height) was found while investigating the shallowest of the hard-bottom features located nearby in Viosca Knoll Block 862. It is not known if this peak was along the Moore and Bullis trawl track.

Deepwater coral habitats have been shown to be much more extensive and important to the support of diverse communities of associated fauna than previously known in the GOM. Although *Lophelia* is best represented in water depths of the upper slope, it has been reported as deep as 3,000 m (9,842 ft) in some parts of the world. Additional studies funded by BOEMRE are in progress or in earlier stages of development that will further investigate the distribution of deepwater corals and other important nonchemosynthetic communities in the deep GOM. Considering the depth of this resource, >300 m (984 ft), these deepwater communities would be beyond the impacts from severe storms or hurricanes, and there has been no alteration of these communities caused from surface storms, including the severe 2005 hurricane season.

Deepwater Horizon Event

The DWH event released an estimated 4.9 million barrels of oil into the water over an 87-day period following the event. Extensive literature, Internet, and database searches have been conducted for results of scientific data. Although many research cruises have occurred, very few scientific results have been published as of this writing. Descriptions of studies completed or in progress are discussed in the previous section on chemosynthetic communities (**Chapter 4.1.1.8**). Possible impacts to nonchemosynthetic communities are discussed below. These impacts relate mostly to the CPA area, which was directly affected by the DWH event. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of the plumes and visible sheens related to oil from the DWH event extended no farther west than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). As such, it appears that nonchemosynthetic deepwater benthic communities in the WPA were not affected by the DWH event. Even if oil from the DWH event reached the WPA, it was likely heavily diluted and, thus, significant impacts would not be expected.

As noted above, studies and data are continuing to be developed in response to the DWH event. This information will likely be developed through the NRDA process. It may be years before this information becomes available, and certainly not within the timeframe of this Supplemental EIS process. Although this information may be relevant to reasonably foreseeable adverse effects on nonchemosynthetic deepwater benthic communities in the WPA, this information remains incomplete or unavailable at this time, regardless of the costs that would otherwise be necessary to obtain this information. What credible scientific information is available was applied using accepted methodologies. Regardless, complete data are not essential to a reasoned choice among alternatives because of the distance of the WPA from the most western extent of the sheen and plumes from the Macondo well (making any impacts extremely remote); the expectation that, if oil from DWH did reach the WPA, it would have been heavily diluted; and the fact that these communities exist in a dynamic environment.

4.1.1.9.2. Impacts of Routine Events

Background/Introduction

A detailed description of the possible impacts from routine activities associated with the WPA proposed action on nonchemosynthetic communities is presented in Chapter 4.2.1.1.4.2.2 of the Multisale EIS and in Chapter 4.1.5.2.2 of the 2009-2012 Supplemental EIS. Similar to chemosynthetic communities, benthic communities other than chemosynthetic organisms could be impacted by physical impacts from drilling discharges, structure placement (including templates or subsea completions), anchoring, or pipeline installation.

Both widespread soft-bottom and rare hard-bottom, nonchemosynthetic deepwater benthic communities are susceptible to physical impacts from drilling discharges, structure placement (including templates or subsea completions), anchoring, and pipeline installation. Sediment from drilling discharges can clog feeding mechanisms of filter and suspension feeders such as mussels, clams, and tube worms. In deep water as opposed to shallower areas on the continental shelf, discharges of drilling fluids and cuttings at the surface are spread across broader areas of the seafloor and are generally distributed in thinner accumulations. The result of this dispersion is that seafloor habitats receive little additional sedimentation from drilling discharges in areas where it settles to the seafloor. Small amounts of sedimentation are normal for these environments. Structure placement, anchoring, and pipeline activities can physically crush organisms on or in the seafloor sediments.

The physical disturbances by structures themselves are typically limited to anchors for holding floating drilling or production facilities over the well sites. Anchoring would not necessarily directly destroy small infaunal organisms living within the sediment. The bottom disturbance would most likely change the environment to such an extent that the majority of the directly impacted infauna community would not survive (e.g., burial or relocation to sediment layers without sufficient oxygen), but adjacent populations of all size classes of organisms would quickly repopulate the modified sediment. In addition, increased surface roughness (rugosity) resulting from anchor or related disturbance of mud bottom would positively impact the habitat value for many infaunal and epifaunal groups as a result of increased habitat complexity. In cases of carbonate outcrops or reefs with attached epifauna or coral, the impacted area of disturbance may be small in absolute terms, but it could be a large portion of the local area inhabited by fragile hard corals or other organisms that rely on exposed hard substrate. Anchors from support boats and ships (or any buoys set out to moor vessels), floating drilling units, barges used for the construction of platform structures, pipelaying vessels, and pipeline repair vessels could also cause severe disturbances to small areas of the seafloor.

Normal pipelaying activities in deepwater areas could impact areas of hard-bottom nonchemosynthetic organisms if they were crossed by the pipeline (pipeline burial is not required at depths where deepwater, hard-bottom communities are found). Impacts of pipeline contact on soft bottoms would be minimal.

Proposed Action Analysis

The routine activities associated with the WPA proposed action that would impact nonchemosynthetic benthic communities would come from activities associated with drilling discharges, structure placement (including templates or subsea completions), anchoring, or pipeline installation. For the WPA proposed action, 5-8 production structures ranging from small subsea developments to large developments involving floating, fixed, or subsea structures are estimated to be installed during the 40-year analysis period in Subareas W200-400, W400-800, W800-1600, W1600-2400, and W>2400 m (**Table 3-2**). Drilling muds and cuttings discharged at the seafloor or from the surface would have some limited impact to soft-bottom communities at or below the sediment/water interface. The surface discharge of muds and cuttings in deeper water would reduce or eliminate the impact of smothering the benthic communities on the bottom due to increased dispersal. Even in situations where the substantial burial of typical benthic infaunal communities occurred, recolonization from populations from neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms. An additional analysis of muds and cuttings discharge impacts appears in Chapter 4.1.1.4.1 of the Multisale EIS.

Physical disturbance or destruction of a limited area of benthos or to a limited number of megafauna organisms such as brittle stars, sea pens, or crabs would not result in a major impact to the deepwater benthos ecosystem as a whole. Under the current review procedures for chemosynthetic communities, carbonate outcrops are targeted as one possible indication (surface amplitude anomaly on 3D seismic survey data) of the presence of chemosynthetic seep communities. Unique communities that may be associated with any carbonate outcrops or other topographical features can be identified via this review, along with the chemosynthetic communities. Typically, all areas suspected of being hard bottom are avoided as geological hazards for any well sites. Any proposed activity in water depth >300 m (984 ft) would automatically trigger the NTL 2009-G40 evaluation described above.

Impacts of pipeline contact on soft bottoms would be minimal because pipeline burial is not required in water depths <61 m (200 ft). Hard-bottom areas would be avoided for the same reasons described above.

Summary and Conclusion

Some impact to soft-bottom benthic communities from drilling and production activities would occur as a result of physical impact from drilling discharges, structure placement (including templates or subsea completions), anchoring, and installation of pipelines regardless of their locations. However, even in situations where the substantial burial of typical benthic infaunal communities occurred, recolonization from populations from widespread neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms.

Information included in required hazards surveys for oil and gas activities depicts areas that could potentially harbor nonchemosynthetic communities. This allows BOEMRE to require avoidance of any areas that are conducive to the growth of sensitive hard-bottom habitats. Impacts to hard-bottom communities are expected to be avoided as a consequence of the application of the existing NTL 2009-G40 guidelines for chemosynthetic communities. The same geophysical conditions associated with the potential presence of chemosynthetic communities also results in the potential occurrence of hard carbonate substrate and nonchemosynthetic communities. Because of the NTL 2009-G40 guidelines, these communities are generally avoided in exploration and development planning.

Based on the additional information presented above, BOEMRE has reexamined the analysis for impacts to nonchemosynthetic communities presented in the Multisale EIS and the 2009-2012 Supplemental EIS. No significant new information was found that would alter the overall conclusion that impacts on nonchemosynthetic communities from routine activities associated with the WPA proposed action would be minimal to none.

4.1.1.9.3. Impacts of Accidental Events

Background/Introduction

A detailed description of accidental impacts on nonchemosynthetic deepwater benthic communities can be found in Chapter 4.4.4.2.2 of the Multisale EIS and in Chapter 4.1.5.3.2 of the 2009-2012 Supplemental EIS. The following is a summary of that information with consideration of new information found since publication of the Multisale EIS and the 2009-2012 Supplemental EIS.

Accidental events that could impact nonchemosynthetic deepwater benthic communities are primarily limited to seafloor blowouts. Surface oil and chemical spills are not considered to be a potential source of measurable impacts on nonchemosynthetic communities because of the water depths at which these communities are located. A blowout at the seafloor could create a crater and could resuspend and disperse large quantities of bottom sediments within a 300-m (984-ft) radius from the blowout site. This would destroy any organisms located within that distance by burial or modification of narrow habitat quality requirements. Physical disturbance or destruction of a limited area of benthos or to a limited number of megafauna organisms (e.g., brittle stars, sea pens, and crabs) would not result in a major impact to the deepwater benthos ecosystem as a whole or even in relation to a small area of the seabed within a lease block. The application of avoidance criteria for deepwater coral communities recommended by NTL 2009-G40 precludes the placement of a well within 610 m (2,000 ft) of any suspected site of a deepwater coral community.

All known reserves in the Gulf of Mexico have specific gravity characteristics that would preclude oil from sinking immediately after release at a blowout site. As discussed in Chapter 4.3.1.5.4 of the Multisale EIS, oil discharges that occur at the seafloor from a pipeline or loss of well control would rise in the water column and surface almost directly over the source location, thus not impacting sensitive deepwater communities. Therefore, the oil is expected to rise to the sea surface under natural conditions. This behavior is modified when dispersants are applied to the oil on the sea surface or at depth, causing the oil to mix with water. The dispersed oil then begins to biodegrade and may flocculate with particulate matter in the water column, promoting sinking of the particles. The potential for weathered components from a surface slick, not treated with dispersants, to reach a deepwater community in any measurable volume would be very small.

Deepwater coral habitats and other potential hard-bottom communities not associated with chemosynthetic communities appear to be relatively rare. Any hard substrate communities located in deep water would be particularly sensitive to impacts. Impacts to these sensitive habitats could permanently prevent recolonization, with similar organisms requiring hard substrate. Adherence to the guidance provided in NTL 2009-G40 should prevent all but minor impacts to hard-bottom communities located the prescribed distance of more than 610 m (2,000 ft) from a well site. Under the current review procedures, carbonate outcrops (high reflectivity surface anomalies on 3D seismic survey data) are targeted as one possible indication that sensitive hard-bottom communities are present. Typically, all areas suspected of being hard bottom are avoided as a potential geological hazard for any well sites. Any proposed impacting activity in water depths >300 m (984 ft) automatically triggers the evaluation as described in NTL 2009-G40.

Proposed Action Analysis

For water depths >300 m (984 ft), 29-37 blowouts are estimated for the WPA proposed action over the 2007-2046 period (Table 4-5 of the Multisale EIS). Resuspended sediments caused from a blowout would have minimal impacts on the full spectrum of soft-bottom community animals, including the possible mortality of a few megafauna specimens such as crab or shrimp. The application of avoidance criteria for sensitive deepwater communities recommended by NTL 2009-G40 should preclude a blowout from affecting hard-bottom communities located the prescribed distance of more than 610 m (2,000 ft) from a well site.

The risk of various sizes of oil spills occurring in the WPA is presented in **Table 3-5**. The possibility of a spill >10,000 bbl in the WPA is estimated to be up to one spill during the 40-year period of the proposed action. The possibility of oil from a surface spill reaching depths of 300 m (984 ft) or greater in any measurable concentration is very small. A catastrophic spill, like the DWH event, could affect nonchemosynthetic community habitat if dispersants are applied on the sea surface or at depth. The dispersed oil would be suspended in the water column and would begin to flocculate with particulate matter until it becomes heavy enough to sink and contact the seafloor. Since oil plumes would be carried by underwater currents, the impacts would be distributed in a line from the source toward the direction that the water currents travel. Oil plumes reaching nonchemosynthetic communities could cause oiling of organisms, resulting in the death of entire populations on localized sensitive habitats. These potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. Habitats directly in the path of the oil plume when the oil contacts the seafloor would be affected. In addition, sublethal effects are possible for communities that receive a lower level of impact. These effects could include temporary lack of feeding, expenditure of energy to remove the oil, loss of gametes and reproductive delays, loss of tissue mass, and similar effects.

Summary and Conclusion

Accidental events resulting from the WPA proposed action are expected to cause little damage to the ecological function or biological productivity of widespread, typical, deep-sea benthic communities. Some impact to benthic communities would occur as a result of impact from an accidental blowout. Megafauna and infauna communities at or below the sediment/water interface would be impacted by the physical disturbance of a blowout or by burial from resuspended sediments. However, even in situations where the substantial burial of typical soft benthic communities occurred, recolonization by populations from neighboring substrate would be expected over a relatively short period of time. For all size ranges of organisms, this can be in a matter of hours to days for bacteria and about 1-2 years for most all macrofauna species.

Impacts to deepwater coral habitats and other potential hard-bottom communities will likely be avoided as a consequence of the application of the policies described in NTL 2009-G40. The rare, widely scattered, high-density, Bush Hill-type nonchemosynthetic communities located at more than 610 m (2,000 ft) away from a blowout could experience minor impacts from resuspended sediments. If dispersants are applied to an oil spill, oil would mix into the water column, be carried by underwater currents, and eventually contact the seafloor where it may impact patches of sensitive deepwater community habitat in its path. These potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution.

The BOEMRE has reexamined the analysis for impacts to nonchemosynthetic communities presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented above. No new information was found to indicate that accidental impacts associated with the WPA proposed action would result in more than minimal impacts to nonchemosynthetic communities. One exception would be in the case of a catastrophic spill combined with the application of dispersant, producing the potential to cause devastating effects on local patches of habitat in the path of subsea plumes where they contact the seafloor. Periods as long as hundreds of years are required to reestablish a chemosynthetic seep community once it has disappeared (depending on the community type), although it may reappear relatively quickly once the process begins.

4.1.1.9.4. Cumulative Impacts

Background/Introduction

A detailed description of cumulative impacts upon deepwater benthic communities of the WPA can be found in Chapter 4.5.4.2 of the Multisale EIS and in Chapter 4.1.5.4 of the 2009-2012 Supplemental EIS (USDOI, MMS, 2007b and 2008a, respectively). The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Cumulative factors considered to impact the deepwater benthic communities of the Gulf of Mexico include both oil- and gas-related and non-oil- and non-gas-related activities. The latter type of impacting factors includes activities such as fishing and trawling at a relatively small scale, and large-scale factors such as storm impacts and climate change.

There are essentially only three fish (or "shellfish") species considered important to deepwater commercial bottom fisheries—the yellowedge grouper, tilefish, and royal red shrimp. Each of these is discussed in Chapter 4.5.4.2 of the Multisale EIS. Unlike other areas in the Atlantic and in Europe, bottom fishing and trawling efforts in the deeper water of the WPA are currently minimal, and impacts to deepwater benthic communities are negligible.

Other regional non-oil- and non-gas-related sources of cumulative impact to deepwater benthic communities would be possible, but they are considered unlikely to occur. Essentially no anchoring from non-OCS-related activities occurs at the deeper water depths considered for these resources (>300 m; 984 ft). Some impacts are highly unlikely yet not impossible, such as the sinking of a ship or barge, resulting in collision or contaminant release directly on top of a sensitive, high-density, nonchemosynthetic community.

The greatest potential for cumulative adverse impacts to occur to the deepwater benthic communities would come from those OCS-related, bottom-disturbing activities associated with pipeline and platform emplacement (including templates and subsea completions), associated anchoring activities, discharges of muds and cuttings, and seafloor blowout accidents. The potential impacts to deepwater benthic communities from these activities were discussed in detail in Chapter 4.5.4.2 of the Multisale EIS.

As exploration and development continue on the Federal OCS, activities have moved farther into the deeper water areas of the Gulf of Mexico. With this trend comes the certainty that increased development would occur on discoveries throughout the entire depth range of the WPA; these activities would be accompanied by limited unavoidable impacts to the soft-bottom deepwater benthos from bottom disturbances and disruption of the seafloor from associated activities. The extent of these disturbances would be determined by the intensity of development in these deepwater regions, the types of structures and mooring systems used, and the effective application of the avoidance criteria as described in NTL 2009-G40 (USDOI, MMS, 2009c). All activity levels for the cumulative scenario in the WPA are shown in Table 4-5 of the Multisale EIS. For the WPA deepwater, offshore Subareas W200-400, W400-800 W800-1600, W1600-2400, and W>2400, there are currently an estimated 14-23 exploration and delineation wells and 68-118 development wells to be drilled and 5-8 production structures to be installed through the 40-year analysis period (**Table 3-2**).

Routine discharges of drilling muds and cuttings have been documented to reach the seafloor in water depths >300 m (984 ft), and the impacts have been analyzed in the Multisale EIS, including the results from a study by CSA (2006b), *Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico*. Potential local cumulative impacts could result from accumulations of muds and cuttings resulting from consistent hydrographic conditions and drilling of multiple wells from the same location, causing concentrations of material in a single direction or "splay." It is not expected that detectable levels of muds and cuttings discharges from separate developments or from adjacent lease blocks would act as a cumulative impact to deepwater benthic communities due their physical separation and great water depths.

Numerous new deepwater communities were recently discovered and explored using the submersible *Alvin* in 2006 and with the remotely operated vehicle *Jason II* in 2007 as part of a new Agency-funded study (Brooks et al., 2009). These new communities were targeted using the same procedures integral to the biological review process and the use of NTL 2009-G40 guidelines targeting areas of potential community areas to be avoided by impacting oil and gas activities. There is no reason to expect an increased vulnerability of these deep communities to cumulative impacts.

A blowout at the seafloor could resuspend large quantities of bottom sediments and even create a large crater, destroying any organisms in the area. Structure removals and other bottom-disturbing activities could resuspend bottom sediments, but not at magnitudes as great as blowout events. Subsea structure removals are not expected in water depths >800 m (2,625 ft), in accordance with 30 CFR 250. The distance of separation provided by adherence to the guidelines of NTL 2009-G40 would protect nonchemosynthetic communities from sedimentation effects of deepwater blowouts. It is reported that chemically dispersed surface oil from the DWH event remained in the top 6 m (20 ft) of the water column, where it mixed with surrounding waters and biodegraded (Lubchenco et al., 2010). Data from other studies on dispersant usage on surface plumes indicate that a majority of the dispersed oil remained in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a). Therefore, oil spills on the sea surface are expected to have little to no effect on deepwater communities.

Subsea oil plumes resulting from a seafloor blowout could affect sensitive deepwater communities. This is especially true if dispersants are applied at depth. A recent report documents damage to a deepwater coral community in an area that oil plume models predicted as the direction of travel for subsea oil plumes from the DWH event. Results are still pending but it appears that a coral community about 15 m x 40 m (50 ft x 130 ft) in size was severely damaged, possibly the result of oil impacts (USDOI, BOEMRE, 2010j). Such blowouts are rare and may not release catastrophic quantities of oil. Oil that is released would be carried in whatever direction the water currents flow. This directional flow could only affect seafloor habitats that are downstream from the source. Sensitive deepwater communities appear to be widely scattered and not as rare as previously expected. Recent BOEMRE analyses of seafloor remote-sensing data indicate over 15,000 locations in the deep GOM that represent potential hard-bottom habitats. While it is likely that any subsea oil plume traveling more than a few miles on the deep seafloor would encounter at least one of these potential habitats, it would result in a localized effect that is not expected to alter the wider population of the GOM.

In cases where high-density communities are subjected to greatly dispersed cumulative discharges or suspended sediments, the impacts are most likely to be sublethal in nature and limited in areal extent. The impacts to ecological function of high-density communities would be minor; minor impacts to ecological relationships with the surrounding benthos would also be likely.

Because of the great water depths, treated sanitary wastes and produced waters are not expected to have any adverse cumulative impacts to any deepwater benthic communities. These effluents would undergo a great deal of dilution and dispersion before reaching the bottom, if ever.

Oil and chemical spills (potentially from non-OCS-related activities) are not considered to be a potential source of measurable impacts on any deepwater communities because of water depth. Oil spills from the surface would tend to float. Oil discharges at depth or on the bottom would tend to rise in the water column and similarly not impact the benthos unless dispersants are applied at depth.

Deepwater coral and other hard-bottom communities not associated with nonchemosynthetic communities are also expected to be protected from cumulative impacts by general adherence to guidance described in NTL 2009-G40 and the shallow hazards NTL 2008-G05 due to the avoidance of areas represented as hard bottom on surface anomaly maps derived from 3D seismic records (USDOI, MMS, 2008c and 2009c). Biological reviews are performed on all deepwater plans (exploration and production) and pipeline applications, which include an analysis of maps and the avoidance of hard-bottom areas that are also one of several important indicators for the potential presence of nonchemosynthetic communities.

Summary and Conclusion

Cumulative impacts to deepwater communities in the Gulf of Mexico from sources other than OCS activities are considered negligible. The most serious, impact-producing factor threatening nonchemosynthetic communities is physical disturbance of the seafloor, which could destroy the organisms of these communities. Such disturbance would most likely come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Drilling discharges and resuspended sediments have a potential to cause minor, mostly sublethal impacts to nonchemosynthetic communities, but substantial accumulations could result in more serious impacts. Seafloor disturbance is considered to be a threat only to the high-density communities; widely distributed low-density communities would not be at risk. Possible catastrophic oil spills due to seafloor blowouts have the potential to devastate localized deepwater benthic habitats. However, these events are rare and would only affect a small portion of the sensitive benthic habitat in the GOM. Recent analyses reveal over 15,000 possible hard-bottom locations across the deepwater GOM. However, because of the guidance provided in NTL 2009-G40 that describes required surveys and avoidance prior to drilling or pipeline installation, the risk would be greatly reduced. New studies have refined predictive information and confirmed the effectiveness of these provisions throughout all depth ranges of the Gulf of Mexico (Brooks et al., 2009). With the dramatic success of this project, confidence is increasing regarding the use of geophysical signatures for the prediction of nonchemosynthetic communities.

Activities unrelated to the OCS Program include fishing and trawling. Because of the water depths in these areas (>300 m; 984 ft) and the low density of potentially commercially valuable fishery species, these activities are not expected to impact deepwater benthic comminutes. Regionwide and even global impacts from CO_2 build-up and proposed methods to sequester carbon in the deep sea (e.g., ocean fertilization) are not expected to have major impacts to deepwater habitats in the near future. More distant scenarios could include severe impacts.

The activities considered under the cumulative scenario are expected to cause little damage to the ecological function or biological productivity of the widespread, low-density deepwater communities. The rarer, widely scattered, high-density, Bush Hill-type communities could experience isolated minor impacts from drilling discharges or resuspended sediments, with recovery expected within several years, but even minor impacts are not expected. Major impacts to localized benthic habitat are possible in the event of a catastrophic blowout on the seafloor, but the probability of this occurring is low. If physical disturbance (such as anchor damage) or extensive burial by muds and cuttings were to occur to high-density, Bush Hill-type communities, impacts could be severe, with recovery time as long as 200 years for mature communities. There is evidence that substantial impacts on these communities would permanently prevent reestablishment. The severity of such an impact is such that there would be incremental losses of productivity, reproduction, community relationships, overall ecological functions of the community, and incremental damage to ecological relationships with the surrounding benthos. The possible impacts to these communities are decreased through BOEMRE's biological review process and the use of NTL 2009-G40, which physically distances petroleum-producing activities from sensitive deepwater benthic communities.

The incremental contribution of the WPA proposed action to cumulative impacts is expected to be slight and to result from the effects of the possible impacts caused by physical disturbance of the seafloor and minor impacts from sediment resuspension or drill cutting discharges. Adverse impacts will be limited but not completely eliminated by adherence to guidelines in NTL 2009-G40.

4.1.1.10. Marine Mammals

The BOEMRE has reexamined the analysis of the 29 species of marine mammals occurring in the Gulf of Mexico presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below and in consideration of the DWH event. The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS. A summary of those analyses and their reexamination due to new information is presented in the following sections.

4.1.1.10.1. Description of the Affected Environment

A detailed description of marine mammals can be found in Chapter 3.2.3 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.6 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The U.S. Gulf of Mexico marine mammal community is diverse and distributed throughout the northern Gulf waters. Twenty-one species of cetaceans regularly occur in the Gulf of Mexico (Jefferson et al., 1992; Davis et al., 2000) and are identified in the NMFS Stock Assessment Reports for the Gulf of Mexico (Waring et al., 2010), in addition to one species of Sirenian. The Gulf of Mexico's marine mammals are represented by members of the taxonomic order Cetacea, which is divided into the suborders Mysticeti (i.e., baleen whales) and Odontoceti (i.e., toothed whales), as well as the order Sirenia, which includes the manatee and dugong. Most GOM cetacean species have worldwide distributions; however, two exceptions are Atlantic spotted dolphins (*Stenella frontalis*) and Clymene dolphins (*Stenella clymene*). Common in the Gulf, these two species are found only in the Atlantic Ocean and its associated waters.

There are species that have been reported from Gulf waters, either by sighting or stranding, that are not considered further in this document. These species include the blue whale (*Balaenoptera musculus*), the North Atlantic right whale (*Eubalaena glacialis*), and the Sowerby's beaked whale (*Mesolplodon bidens*), all considered extralimital in the GOM; and the humpback whale (*Megaptera novaeangiliae*), the fin whale (*Balaenoptera physalus*), the sei whale (*Balaenoptera borealis*), and the minke whale (*Balaenoptera acutorostrata*), all considered rare occasional migrants in the GOM (Wursig et al., 2000;

Mullin and Fuling, 2004). Because these species are uncommon in the GOM (and by extension the WPA), they are not included in the most recent NMFS Stock Assessment Reports for the Gulf of Mexico (Waring et al., 2010).

Threatened and Endangered Species

There is only one cetacean, the sperm whale (*Physeter macrocephalus*), and one sirenian, the West Indian manatee (*Trichechus manatus*), that regularly occur in the GOM and that are listed as endangered under the ESA. The sperm whale is common in oceanic waters of the northern Gulf of Mexico and appears to be a resident species. The life history, population dynamics, status, distribution, behavior, and habitat use of baleen and toothed whales can be found in Chapters 3.2.3.1.1 and 3.2.3.1.2 of the Multisale EIS, respectively.

Palka and Johnson (2007) present the results of a study that collected the dive patterns of sperm whales in the Atlantic Ocean to compare them with the dive patterns and social structure of sperm whales in the Gulf of Mexico. The study started a baseline of line transect, photo-identification, oceanographic, and genetic data for the Atlantic sperm whale. Compared with the Mississippi River Delta in the Gulf of Mexico, parts of the Atlantic Ocean may serve as a control population of sperm whales with little exposure to sounds of oil- and gas-related activities. The study found that Gulf of Mexico sperm whales follow a foraging and socializing cycle similar to that seen for the North Atlantic whales, but North Atlantic sperm whales dive significantly deeper (average 934 m [3,064 ft] compared with 639 m [2,096 ft] for Gulf of Mexico whales) when foraging (Palka and Johnson, 2007). Jochens et al. (2008) published a synthesis of work conducted as the Sperm Whale Seismic Study in the Gulf of Mexico. Genetic data from this study confirm that the Gulf of Mexico sperm whales constitute a distinct stock from other Atlantic sperm whale stocks.

The NOAA recently published a final recovery plan for the sperm whale (USDOC, NMFS, 2010b), and current threats to sperm whale populations worldwide are discussed. Threats are defined as "any factor that could represent an impediment to recovery" and include fisheries interactions, anthropogenic noise, vessel interactions, contaminants and pollutants, disease, injury from marine debris, research, predation and natural mortality, direct harvest, competition for resources, loss of prey base due to climate change and ecosystem change, and cable laying. In the GOM, the impacts from many of these threats are identified as either low or unknown (Waring et al., 2010). For example, the Recovery Plan states that the impacts from fisheries are low since sperm whales may break through fishing gear. However, they may die later as a result of the entanglement, but the death would go unreported. Further, it states, "During 2001-2005, human-caused mortality was estimated at 0.2 sperm whales per year (0.0 sperm whales per year from fisheries and 0.2 from ship strikes) off the east coast of the U.S. (Waring et al., 2010)." In regards to the effects of anthropogenic noise, the Recovery Plan states that it is "difficult to ascertain and research on this topic is ongoing. The possible impacts of the various sources of anthropogenic noise, described below, have not been well studied on sperm whales. The threat occurs at an unknown severity and there is a high level of uncertainty associated with the evidence described below. Thus, the relative impact of anthropogenic noise to the recovery of sperm whales is ranked as "unknown."

Manatees primarily inhabit open coastal (shallow nearshore) areas and estuaries, and they are also found far up in freshwater tributaries. During warmer months, manatees are common along the Gulf Coast of Florida from the Everglades National Park northward to the Suwannee River in northwestern Florida, and they are less common farther westward. In winter, the Gulf of Mexico subpopulations move southward to warmer waters. The winter range is restricted to waters at the southern tip of Florida and to waters near localized warm-water sources, such as power plant outfalls and natural springs in west-central Florida.

Florida manatees have been divided into four distinct regional management units: the Atlantic Coast Unit that occupies the east coast of Florida, including the Florida Keys and the lower St. Johns River north of Palatka, Florida; the Southwest unit that occurs from Pasco County, Florida, south to Whitewater Bay in Monroe County, Florida; Upper St. Johns River Unit that occurs in the river south of Palatka, Florida; and the Northwest Unit that occupies the Florida Panhandle south to Hernando County, Florida (Waring et al., 2009). Manatees from the Northwest Unit are more likely to be seen in the northern GOM and can be found as far west as Texas; however, most sightings are in the eastern Gulf of Mexico.

The best available count of Florida manatees is 3,802 animals, based on a January 2009 aerial survey of warm-water refuges (Waring et al., 2009). In 2010, of the 767 manatee carcasses collected in Florida, 88 of these animals died of human causes (Florida Fish and Wildlife Commission, 2010). Human causes included water control structures, entanglement in and ingestion of marine debris, entrapment in pipes/culverts, and collisions with watercraft. Ninety-four percent of manatees that died of human causes were killed by watercraft (FWC FWRI Manatee Mortality Statistics, 2010).

Recent Section 7 Endangered Species Act Consultation

As mandated by the ESA, BOEMRE consulted with NMFS and FWS on possible and potential impacts from a WPA proposed action on endangered/threatened species and designated critical habitat under their jurisdiction. A biological assessment was prepared for each consultation. The action area analyzed in the biological assessments included the lease sale areas addressed in this Supplemental EIS.

The formal ESA consultation with NMFS was concluded with receipt of the Biological Opinion on July 3, 2007 (USDOC, NMFS, 2007b). The Biological Opinion concludes that the proposed lease sales and associated activities in the Gulf of Mexico in the current 5-Year Program are not likely to jeopardize the continued existence of threatened and endangered species under NMFS jurisdiction or destroy or adversely modify designated critical habitat. The following information was present in the Biological Opinion(USDOC, NMFS, 2007b). Based on NOAA's surveys, opportunistic sightings, and stranding records, sperm whales in the Gulf of Mexico occur year-round. Sperm whales appear to favor water depths of about 1,000 m (3,281 ft) and appear to be concentrated in at least two geographic regions of the northern Gulf of Mexico: (1) an area off the Dry Tortugas and (2) offshore of the Mississippi River Delta (Maze-Foley and Mullin, 2006). However, distribution also appears influenced by the occurrence and movement of cyclonic/anticyclonic currents in the Gulf of Mexico. The ESA consultation with FWS was concluded with a letter dated September 14, 2007. The FWS concurred with the BOEMRE's determination that proposed actions of the current 5-Year Program were not likely to adversely affect the threatened/endangered species or designated critical habitat under FWS jurisdiction.

Following the DWH event on July 30, 2010, BOEMRE requested reinitiation of ESA consultation with both NMFS and FWS. The NMFS responded with a letter to BOEMRE on September 24, 2010. The FWS responded with a letter to BOEMRE on September 27, 2010. The reinitiated consultations are not complete at this time, although BOEMRE is in discussions with both agencies. In the meantime, the current consultation remains in effect and recognizes that BOEMRE-required mitigations and other reasonable and prudent measures should reduce the likelihood of impacts from BOEMRE-authorized activities. Further, BOEMRE has determined, under Section 7(d) of the ESA, that the proposed action of this Supplemental EIS is not an irreversible or irretrievable commitment of resources, which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures. The BOEMRE is also developing an interim coordination program with NMFS and FWS while consultation is ongoing.

Non-ESA Listed Marine Mammals

One baleen cetacean (Bryde's whale) and 20 toothed cetaceans (including beaked whales and dolphins) occur in the Gulf of Mexico (**Table 4.2**). None of these species are protected under the ESA (except sperm whale); however all marine mammals are protected under the Marine Mammal Protection Act (1972). The life history, population dynamics, status, distribution, behavior, and habitat use of the nonendangered baleen and toothed whales can be found in Chapters 3.2.3.2.1 and 3.2.3.2.2 of the Multisale EIS, respectively.

Factors Influencing Cetacean Distribution and Abundance

The distribution and abundance of cetaceans within the northern Gulf of Mexico is strongly influenced by various mesoscale oceanographic circulation patterns. These patterns are primarily driven by river discharge (primarily the Mississippi/Atchafalaya Rivers), wind stress, and the Loop Current and its derived circulation phenomena. Circulation on the continental shelf is largely wind-driven, with localized effects from freshwater (i.e., river) discharge. Beyond the shelf, mesoscale circulation is largely driven by the Loop Current in the eastern Gulf of Mexico. Approximately once or twice a year, the Loop

Current sheds anticyclonic eddies (also called warm-core rings). Anticyclones are long-lived, dynamic features that generally migrate westward and transport large quantities of high-salinity, nutrient-poor water across the near-surface waters of the northern Gulf of Mexico. These anticyclones, in turn, spawn cyclonic eddies (also called cold-core rings) during interaction with one another and upon contact with topographic features of the continental slope and shelf edge. These cyclones contain and maintain high concentrations of nutrients and stimulate localized production (Davis et al., 2000). In the north-central Gulf of Mexico, the relatively narrow continental shelf south of the Mississippi River Delta may be an additional factor affecting cetacean distribution (Davis et al., 2000). Outflow from the mouth of the Mississippi River transports large volumes of low-salinity, nutrient-rich water southward across the continental shelf and over the slope. River outflow also may be entrained within the confluence of a cyclone-anticyclone eddy pair and transported beyond the continental slope. Marine predators such as the bottlenose dolphin focus their foraging efforts on these abundant prey locations to improve overall efficiency and reduce energy costs (Bailey and Thompson, 2010).

Unusual Mortality Event for Cetaceans in the Gulf of Mexico

On December 13, 2010, NMFS declared an unusual mortality (UME) for cetaceans (whales and dolphins) in the Gulf of Mexico. An UME is defined under the Marine Mammal Protect Act as a "stranding that is unexpected, involves a significant die-off of any marine mammal population, and demands immediate response." Evidence of the UME was first noted by NMFS as early as February 2010. As indicated in the list below, a total of 486 cetaceans have stranded since the start of the UME, with a vast majority of these strandings involving premature, stillborn, or neonatal bottlenose dolphins between Franklin County, Florida, and the Louisiana/Texas border (just east of the WPA). More detail on the UME can be found on NMFS's website (USDOC, NMFS, 2011a).

Unusual Mortality Event Cetacean Data for the Northern Gulf of Mexico

(Numbers are preliminary and may be subject to change. As of June 26, 2011, the UME involves 486 cetacean "strandings" in the northern Gulf of Mexico [USDOC, NMFS, 2011a]).

Cetaceans Stranded	Phase of Oil-Spill Response	Dates
113 cetaceans stranded	prior to the response phase for the oil spill	February 1, 2010 - April 29, 2010
115 cetaceans stranded or were reported dead offshore	during the initial response phase to the oil spill	April 30, 2010 - November 2, 2010
258 cetaceans stranded*	after the initial response phase ended	November 3, 2010 - June 26, 2011**

* This number includes 6 dolphins that were killed incidental to fish-related scientific data collection.
** The initial response phase ended for all four states on November 3, 2010, but then re-opened for eastern and central Louisiana on December 3, 2010.

It is unclear at this time whether the increase in strandings is related partially, wholly, or not at all to the DWH event. According to NMFS' website referenced above, the only publicly available source of information at this time on the UME, evidence of the UME was first documented by NMFS as early as February 2010, several months prior to the DWH incident. The NMFS has also documented an additional 11 UME's that have been previously declared in the GOM for cetaceans since 1991. However, the current data in the table above also shows a marked increase in strandings during the DWH event response and afterwards. According to the website, NMFS considers the investigation into the cause of the UME and the potential role of the DWH event to be "ongoing and no definitive cause has yet been identified for the increase in cetacean strandings in the northern Gulf in 2010 and 2011." It is therefore unclear whether increases in stranded cetaceans during and after the DWH event response period are or are not related to impacts from the DWH event and will likely remain unclear until NMFS completes its UME and NRDA evaluation processes.

***Deepwater Horizon* Event**

The DWH event in Mississippi Canyon Block 252 and resulting oil spill and related spill-response activities (including use of dispersants) have impacted marine mammals that have come into contact with oil and remediation efforts. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010).

For the latest available information on oiled or affected marine mammals documented in the area, event response activities, and daily maps of the current location of spilled oil, see RestoreTheGulf.gov (2010b, last accessed June 29, 2011).

According to the NMFS website's reports on stranded marine mammals during and after the DWH event, 171 marine mammals (the majority of which were deceased) have been collected as of April 20, 2011. This includes 155 bottlenose dolphins, 2 Kogia spp., 2 melon-headed whales, 6 spinner dolphins, 2 sperm whales, and 4 unknown species (USDOC, NMFS, 2011b). All marine mammals collected either alive or dead were found east of the Louisiana/Texas border. Approximately 4 percent of these strandings (7 total) were in close proximity to the Texas/Louisiana border. The remaining strandings (164 total) were approximately 200 km (124 mi) from the Louisiana/Texas border and at an even much greater distance from the NOAA trajectories of approximate oil locations from April 27, 2010, to May 1, 2010 (USDOC, NOAA, 2010i). Due to known low detection rates of carcasses, it is possible that the number of deaths of marine mammals is underestimated (Williams et al., 2011). It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the DWH oil spill.

Marine Mammal Resources in the Western Planning Area

The final determinations on damages to marine mammal resources from the DWH event will ultimately be made through the NRDA process. The DWH event will ultimately allow a better understanding of any realized effects from such a low-probability catastrophic spill. However, the best available information on impacts to marine mammals does not yet provide a complete understanding of the effects of the oil spilled and active response/cleanup activities from the DWH event on marine mammals as a whole in the GOM and whether these impacts reach a population level. There is also an incomplete understanding of the potential for population-level impacts from the ongoing UME. Here, BOEMRE concludes that the unavailable information from these events may be relevant to foreseeable significant adverse impacts to marine mammals. Relevant data on the status of marine mammal populations after the UME and DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. For example, even 20 years after the *Exxon Valdez* spill, long-term impacts to marine mammal populations are still being investigated. (Matkin et al., 2008). Therefore it is not possible for BOEMRE to obtain this information within the timeline contemplated in this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEMRE subject-matter experts have used available scientifically credible evidence in this analysis and based upon accepted methods and approaches.

The BOEMRE does, however, provide the following analyses relevant to the DWH event and UME discussion:

- More species/populations localized in the WPA are unlikely to have been affected by the DWH and UME events. For example, NMFS divides bottlenose dolphins into 37 management stocks, including an eastern coastal (shallow waters to 20-m isobath; 84º W. longitude to Key West, Florida); a northern coastal (shallow waters to 20-m isobath; 84º W. longitude to the Mississippi River Delta); a western coastal (shallow water to 20-m isobath; Mississippi River Delta to the Texas/Mexico border); the GOM continental shelf; oceanic; and bay, sound, and estuarine (Waring et al., 2010). The stocks most likely to be impacted by the UME and/or the DWH event are the bay, sound, and estuarine stocks (32 of the 37 stocks in the GOM). Animals within these stocks exhibit stable patterns of residency, and data suggest that these stocks would require long periods to repopulate if they were severely depleted (Waring et al., 2010). For the most part, however, animals within these stocks likely maintain their ranges within these areas. The NMFS stranding information collected to date (as discussed and cited earlier), whether from the DWH response effort or through the UME, shows clear concentrations of strandings off central and eastern Louisiana and into western Florida (at least 200 km [124 mi] from the WPA). Only a small subset (4%) of strandings has been documented near the Louisiana/Texas border, which also coincides with the eastern edge of the proposed WPA leased sale area. Based on this, the animals affected by the UME or those stranded during or after the DWH event were likely not from bottlenose dolphin stocks found in the WPA.

- Manatees and Bryde's whales, although potentially affected by the DWH event, are not likely found within the WPA and would not be impacted by this proposed action.
- There is the potential for more wide-ranging species (e.g., sperm whales, killer whales, delphinids) to be found in both the WPA and areas affected by the DWH event. For example, Jochens et al. (2008) documented sperm whales throughout the northern GOM; however, their distribution was variable depending on oceanographic features. However, the degree that individuals in the areas affected by the DWH spill will also be found and potentially affected by activities under this proposed action is unclear. Further, there are 1,394 active leases in the WPA, some of which have ongoing exploration, drilling, and production activities or the potential for these activities. Individuals from wide-ranging species that may have been affected by DWH event still have the potential to be affected by these ongoing activities, regardless of whether the proposed action under this Supplemental EIS is implemented.

Nevertheless, a complete understanding of the missing information is not essential to a reasoned choice among alternatives for this Supplemental EIS (including the No Action and Action Alternatives) for three main reasons:

(1) There are 1,394 active leases in the WPA with ongoing (or the potential for) exploration, drilling, and production activities. In addition, non-OCS energy-related activities will continue to occur in the WPA irrespective of this proposed lease sale (i.e., fishing, military activities, and scientific research). The potential for effects from changes to the Affected Environment (post-DWH), Routine Activities, Accidental Spills (including low-probability catastrophic spills), and Cumulative Effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on marine mammals from either smaller accidental events or low-probability catastrophic events will remain the same.

(2) As discussed in the above sections, some marine mammal populations in the WPA do not generally travel throughout areas affected by DWH spilled oil and would not be subject to a changed baseline or cumulative effects from the DWH event (e.g., coastal bottlenose dolphins resident in the WPA). Other marine mammals, such as Bryde's whales and manatees, although potentially affected by DWH, do not typically occur in the WPA.

(3) Other wide-ranging populations of marine mammals (e.g., sperm whales and killer whales) that may occur in the WPA and within areas affected by the spill are unlikely to have experienced population-level effects from the DWH event given their wide-ranging distribution and behaviors.

Further, the analyses in the Multisale EIS, the 2009-2012 Supplemental EIS, and this Supplemental EIS (**Chapter 4.1.1.10.1** [Affected Environment], **Chapter 4.1.1.10.2** [Accidental Spills], and **Appendix B**) conclude that there is a potential for low-probability catastrophic events to result in significant, population-level effects on affected marine mammal species. The BOEMRE continues to agree with these conclusions irrespective of any incomplete information, changes to the existing environment from the DWH event, or even the effectiveness of implementation of the improved post-DWH safety and oil-spill-response requirements.

4.1.1.10.2. Impacts of Routine Events

Background/Introduction

A detailed impact analysis of the marine mammals for proposed WPA Lease Sale 218 can be found in Chapter 4.2.1.1.5 of the Multisale EIS. Impact analyses for the 181 South Area that includes any new information since publication of the Multisale EIS is presented in Chapter 4.1.6.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

Potential effects on marine mammal species may occur from routine activities associated with the WPA proposed action and may be direct or indirect. The major potential impact-producing factors affecting marine mammals as a result of routine OCS activities include the degradation of water quality from operational discharges; anthropogenic noise generated by helicopters, vessels, operating platforms, and drillships; vessel traffic and potential for vessel strikes; explosive structure removals; seismic surveys; and marine debris from service vessels and OCS structures. Most operational discharges are diluted and dispersed when released in offshore areas and are considered to have sublethal effects (NRC, 1983; API, 1989; Kennicutt, 1995; Kennicutt et al., 1996). Any potential impacts from drilling fluids would be indirect, either as a result of impacts to prey species or possibly through ingestion via the food chain (Neff et al., 1989). However, marine mammals are generally not considered good bioaccumulators of petroleum compounds from eating contaminated prey due to rapid metabolism and excretion rates (Neff, 1990). As such, impacts from discharges related to the proposed action would not be expected to result in long-term impacts to marine mammals because these compounds would not assimilated.

Deep-diving whales, such as the sperm whale, may be more vulnerable to vessel strikes given the longer surface period required to recover from extended deep dives. Given that NMFS has determined vessel strikes to be a “discountable” concern (due to BOEMRE’s requirement under NTL 2007-G04 that vessels maintain a distance of 90 m [295 ft] from sperm whales) for sperm whales (USDOC, NMFS, 2007b), a deep-diving species, the faster diving marine mammal species with less surface recovery time would be expected to have even less risk of vessel strikes. Further, there have been no reports of mortality of marine mammals from ship strikes in the Gulf of Mexico. Although manatees have been killed by vessel strikes (e.g., Schiro et al., 1998), they are rare in the offshore GOM waters, and consequently, the proposed activity should pose little, if any, risk to them. The continued presence of sperm whales in close proximity to some of the deepwater structures in the GOM tends to lessen the concern of permanent displacement by disturbances caused by activity in support of offshore drilling or production (Jochens et al., 2008).

It is possible that anthropogenic noise can cause disturbance (subtle changes in behavior, interruption of previous activities, or short- or long-term displacement), masking of sounds (calls from conspecifics, reverberations from own calls, and other natural sounds such as surf or predators), physiological stress, and hearing impairment. Noise associated with the WPA proposed action, including drilling noise, aircraft, and vessels, may affect marine mammals by eliciting a startle response or by masking other underwater sounds necessary for proper feeding or reproductive success.

The dominant source of noise from vessels is from the propeller operation, and the intensity of this noise is largely related to ship size and speed. Vessel noise from activities resulting from the proposed action will produce low levels of noise, generally in the 150- to 170-dB re 1 μPa-m at frequencies below 1,000 Hz. Vessel noise is transitory and generally does not propagate at great distances from the vessel. As a result, NMFS’s 2007 ESA Biological Opinion concluded that the effects to sperm whales from vessel noise are “discountable” due to BOEMRE’s requirement under NTL 2007-G04 that vessels maintain a distance of 90 m (295 ft) from sperm whales (USDOC, NMFS, 2007b). The BOEMRE has proposed adherence with the guidance provided under NTL 2007-G04, “Vessel Strike Avoidance and

Injured/Dead Protected Species Reporting." Compliance with the regulations, as clarified in this NTL, should avoid entirely or minimize the chance of significant impacts to marine mammals from both the presence of a vessel and the noise it produces. Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from whales and dolphins or mask their sound reception. There is the possibility of short-term disruption of movement patterns and behavior, but such disruptions are unlikely to affect survival or productivity. Based on the physics of sound propagation discussed here and with the addition of the BOEMRE requirements under NTL 2007-G04, behavioral disruptions potentially caused by noise and the presence of service-vessel traffic will therefore have negligible effects on cetacean populations in the northern Gulf of Mexico.

The noise and the shadow from helicopter overflights, take-offs, and landings can cause a startle response and can interrupt whales and dolphins while resting, feeding, breeding, or migrating (Richardson et al., 1995). The Federal Aviation Administration's Advisory Circular 91-36D (September 17, 2004) encourages pilots to maintain higher than minimum altitudes over noise-sensitive areas. Guidelines and regulations put in place by NOAA Fisheries under the authority of the Marine Mammal Protection Act include provisions specifying that helicopter pilots maintain an altitude of 1,000 ft (305 m) within 300 ft (91 m) of marine mammals. Helicopter occurrences would be temporary and pass within seconds. Marine mammals are not expected to be adversely affected by routine helicopter traffic operating at prescribed altitudes.

Noise from drilling could be intermittent, sudden, and at times could be high intensity as operations take place. Sound from a fixed, ongoing source like an operating drillship is continuous. However, the distinction between transient and continuous sounds is not absolute on a drillship, as generators and pumps operate essentially continuously; however, there are occasional transient bangs and clangs from various impacts during operations (Richardson et al., 1995). Estimated frequencies from drilling by semisubmersible vessels are broadband from 80 to 4,000 Hz, with an estimated source level of 154 dB re 1μPa at 1 m. Tones of 60 Hz had source levels of 149 dB, 181 Hz was 137 dB, and 301 Hz was 136 dB (Greene, 1986). The potential effects that water-transmitted noise has on marine mammals include disturbance (subtle changes in behavior, interruption of previous activities, or short- or long-term displacement), masking of sounds (calls from conspecifics, reverberations from own calls, and other natural sounds such as surf or predators), physiological stress, and hearing impairment. Individual marine mammals exposed to recurring disturbance could be negatively affected. Malme et al. (1986) observed the behavior of feeding gray whales in the Bering Sea during four experimental playbacks of drilling sounds (50-315 Hz; 21-minute overall duration and 10% duty cycle; source levels of 156-162 dB re: 1 μPa-m). In two cases for received levels 100-110 dB re: 1 μPa, there was no observed behavioral reaction. Avoidance behavior was observed in two cases where received levels were 110-120 dB re: 1 μPa. These source levels are all below NMFS's current 160-dB level B harassment threshold under the MMPA.

The source levels from drilling are relatively low (154 dB and below, as cited by Greene, 1986, in Richardson et al., 1995), below the level B (behavioral) harassment threshold of 160 dB (set by NMFS). According to Southall et al. (2007), for behavioral responses to nonpulses (such as drill noise), data indicate considerable variability in received levels associated with behavioral responses. Contextual variables (such as novelty of the sound to the marine mammal and operation features of the sound source) appear to have been at least as important as exposure level in predicting response type and magnitude. While there is some data from the Arctic on baleen whales, there is little data on the behavioral responses of marine mammals in the Gulf of Mexico from the sound of drilling. Southall et al. (2007) summarized the existing research, stating that the probability of avoidance and other behavioral effects increases when received levels increase from 120 to 160 dB. Marine mammals may exhibit some avoidance behaviors, but their behavioral or physiological responses to noise associated with the proposed action, however, are unlikely to have population-level impacts to marine mammals in the northern Gulf of Mexico.

The BOEMRE published a Programmatic EA on decommissioning operations (USDOI, MMS, 2005) that, in part, addresses the potential impacts of explosive- and nonexplosive-severance activities on OCS resources, particularly upon marine mammals and sea turtles. Pursuant to 30 CFR 250 Subpart Q, operators must obtain a permit from BOEMRE before beginning any platform removal or well-severance activities. During the review of the permit applications, terms and conditions of the August 2006 NMFS Biological Opinion/Incidental Take Statement are implemented for the protection of marine protected species and to reduce possible impacts from any potential activities resulting from the proposed lease sale.

The NMFS has issued regulations (50 CFR 216) under the MMPA for "Taking Marine Mammals Incidental to the Explosive Removal of Offshore Structures in the Gulf of Mexico."

In 30 CFR 250 Subpart B, BOEMRE requires operators of Federal oil and gas leases to meet the requirements of ESA and MMPA. The regulations outline the environmental, monitoring, and mitigation information that operators must submit with plans for exploration, development, and production. This regulation requires OCS activities to be conducted in a manner that is consistent with the provisions of ESA and MMPA.

Seismic operations have the potential to harm marine mammals in close proximity to firing airgun arrays, especially if they are directly beneath airguns when surveying begins. The Protected Species Stipulation and NTL 2007-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," minimize the potential of harm from seismic operations to marine mammals. These mitigations include onboard observers, airgun shut-downs for whales in the exclusion zone, ramp-up procedures, and the use of a minimum sound source.

Mysticetes, as low-frequency hearing specialists, are the species group most likely to be susceptible to impacts from nonpulse sound (intermittent or continuous), given that their hearing ranges overlap most closely with the noise frequencies produced from drilling (Southall et al., 2007). However, most mysticete species that could occur in the GOM (i.e., North Atlantic right, blue, fin, sei, humpback, and minke whales) are considered either "extralimital," "rare," or "uncommon" within the GOM (Wursig et al., 2000; Waring et al., 2010). The Bryde's whale is the only resident baleen whale and is found primarily in the eastern GOM (Waring et al. 2010). Because of the geographic scope of the proposed action, the presence of these species within the proposed action area is unlikely.

The remaining marine mammal species in the GOM (e.g., sperm whales, dwarf or pygmy sperm whales, and dolphins) are considered mid-frequency hearing specialists, with hearing ranges that slightly overlap with sound frequencies produced from drilling noise (Southall et al., 2007). It is expected that there will be some overlap in the frequencies of the drill source and the hearing thresholds of these marine mammals present in the GOM. Greene (1986) estimated the broadband frequencies of semisubmersible drill vessels to be from 80 to 4,000 Hz, with an estimated source level of 154 dB re 1µPa at 1 m. Tones of 60 Hz had source levels of 149 dB, 181 Hz was 137 dB, and 301 Hz was 136 dB. Wartzok and Ketten (1999) stated that bottlenose dolphins have hearing thresholds ranging from less than 5 kHz to over 100 kHz. Ridgway and Carder (2001) found through auditory brainstem analysis that pygmy sperm whales have thresholds from 90 to 150 kHz. Gordon et al. (1996) found that a stranded sperm whale had lower hearing limits at around 100 Hz, while Ridgway and Carder (2001) found that a sperm whale calf had best range of hearing between 5 and 20 kHz. Since there is some overlap in the sound levels produced and the hearing thresholds of these marine mammals, there is potential for the drilling noise produced to cause auditory and nonauditory effects (i.e., behavioral disruptions), permanent threshold shift, temporary threshold shift, behavioral changes, or masking; but, it is expected to be limited because these levels are under the NMFS 160-dB level B harassment criteria under the MMPA.

The NMFS sets the 180-dB root-mean-squared (rms) isopleth where the on-set of auditory injury or mortality (level A harassment) to cetaceans may occur. Southall et al. (2007) suggests this level should rather be at 230 dB rms for a nonpulsed sound, such as drilling noise. Richardson et al. (1995) cited Greene (1986) and stated that drilling from semisubmersible vessels have estimated broadband frequencies from 80 to 4,000 Hz, with an estimated source level of 154 dB re 1microPa at 1 m. Tones of 60 Hz have source levels of 149 dB, while 181 Hz have source levels of 137 dB, and 301 Hz have source levels of 136 dB. These source levels all fall below the 180-dB level A harassment isopleths.

Many types of plastic materials end up as solid waste during drilling and production operations. Some of this material is accidentally lost overboard where cetaceans could consume it or become entangled in it. The incidental ingestion of marine debris and entanglement could adversely affect marine mammals. Industry has made good progress in debris management on vessels and offshore structures in the last several years. The proposed adherence, with the guidance provided under NTL 2007-G03, "Marine Trash and Debris Awareness and Elimination," appreciably reduces the likelihood of marine mammals encountering marine debris from the proposed activity.

Summary and Conclusion

The BOEMRE has reexamined the analysis for marine mammals presented in the Multisale EIS, the 2009-2012 Supplemental EIS, and the cited new information within the discussions above. Based on this evaluation, our analysis of the effects from routine activities on marine mammals remains unchanged from what was concluded in the Multisale EIS and the 2009-2012 Supplemental EIS. Effects from routine activities from the proposed WPA lease sale are not expected to have long-term adverse effects on the size and productivity of any marine mammal species or population in the northern GOM. Lethal effects, if they were to occur, could result from chance collisions with OCS service vessels or the ingestion of any accidentally released plastic materials. However, there have been no reports of mortality from these occurrences in the GOM, and vessel strikes are considered unlikely (also see USDOC, NMFS, 2007b). Instead, most routine OCS activities are expected to have sublethal effects, such as behavioral effects, that are not expected to rise to the level of significance to the populations.

Although there will always be some level of incomplete information on the effects from routine activities under this proposed action on marine mammals, there is credible scientific information, applied using acceptable scientific methodologies, to support the conclusion that any realized impacts would be sublethal in nature and not in themselves rise to the level of reasonably foreseeable significant adverse (population level) effects. Also, routine activities will be ongoing in the proposed action area (WPA) as a result of existing leases and related activities. (In the WPA, there are 1,394 active leases [USDOI, BOEMRE, 2011]). Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that routine activities from the pre-existing OCS program are significantly impacting marine mammal populations. Therefore, a full understanding of any incomplete or unavailable information on the effects of routine activities is not essential to make a reasoned choice among the alternatives.

4.1.1.10.3. Impacts of Accidental Events

A detailed impact analysis of marine mammals for proposed WPA Lease Sale 218 can be found in Chapter 4.4.5 of the Multisale EIS. Impact analyses for the 181 South Area that includes any new information since publication of the Multisale EIS is presented in Chapter 4.1.6.3 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared. This section treats both the expected accidental spill as well as the low-probability, large-volume spill with catastrophic events. Further, general analyses of a catastrophic event in the GOM can also be found in **Appendix B**.

Proposed Action Analysis

For water depths >300 m (984 ft), 29-37 blowouts are estimated for the WPA proposed action over the 2007-2046 period (Table 4-5 of the Multisale EIS). The risk of various sizes of oil spills occurring in the WPA is presented in **Table 3-5**. The possibility of a spill >10,000 bbl in the WPA is estimated to be up to one spill during the 40-year period of the proposed action. The possibility of oil from a surface spill reaching depths of 300 m (984 ft) or greater in any measurable concentration is very small.

Potential effects on marine mammal species may occur from accidental activities associated with the WPA proposed action and may be direct or indirect. The major potential impact-producing factors affecting marine mammals in the GOM as a result of accidental OCS activities include accidental blowouts, oil spills, and spill-response activities. Characteristics of impacts (i.e., acute vs. chronic impacts) depend on the magnitude, frequency, location, and date of accidents; characteristics of spilled oil; spill-response capabilities and timing; and various meteorological and hydrological factors. Chronic or acute exposure may result in harassment, harm, or mortality to marine mammals. Studies have shown varying results. Marine mammals made no apparent attempt to avoid spilled oil in some cases (Smultea and Würsig, 1995); however, marine mammals have been observed apparently detecting and avoiding slicks in other reports (Geraci and St. Aubin, 1990). Since there are reports of oiled marine mammals (see the DWH assessment in the **Chapter 4.1.1.10.4**, "Cumulative Impacts," to follow), exposure to hydrocarbons persisting in the sea following the dispersal of a large oil slick may result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) to marine mammals. The potential effects associated with a low-probability large spill may be more severe than a smaller accidental spill and could potentially contribute to longer-lasting and potentially population-level effects. **Appendix B** discusses, in general, the magnitude and duration of effects possible if the low-probability, large-volume spill were to occur in the GOM.

The oil from an oil spill can adversely affect cetaceans by causing soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil and/or tar, and temporary displacement from preferred habitats. The long-term impacts to marine mammal populations are poorly understood but could include decreased survival and lowered reproductive success. The range of toxicity and degree of sensitivity to oil hydrocarbons and the effects of cleanup activities on cetaceans are unknown.

Impacts from dispersants are unknown but may be irritants to tissues and sensitive membranes (NRC, 2005). One assumption concerning the use of dispersants is that the chemical dispersion of oil will considerably reduce the impacts to marine mammals, primarily by reducing their exposure to petroleum hydrocarbons (French-McCay, 2004; NRC, 2005). However, the impacts to marine mammals from chemical dispersants could include nonlethal injury (e.g., tissue irritation, inhalation), long-term exposure through bioaccumulation, and potential shifts in distribution from some habitats.

Information on the effects of spilled oil on marine mammals was gathered as a result of the 1989 *Exxon Valdez* tanker oil spill in Prince William Sound, Alaska. Of the marine mammal species affected by this spill, the killer whale is the only species to also occur in the GOM. The 2010 Injured Resources & Services Update provided by the *Exxon Valdez* Oil Spill Trust Council determined, although still circumstantial, that declines immediately following the spill in killer whale numbers (primarily the AB and AT1 populations) were likely a result of the inhalation of petroleum or petroleum vapors and possible eating of contaminated fish or oiled harbor seals. Twenty years later, the *Exxon Valdez* Oil Spill Trust Council determined these populations to still be recovering (*Exxon Valdez* Oil Spill Trust Council, 2010; Matkin et al., 2008).

There have been no experimental studies and only a handful of observations suggesting that oil has harmed any manatees (St. Aubin and Lounsbury, 1990). The types of impacts to manatees and dugongs from contact with oil include (1) asphyxiation due to inhalation of hydrocarbons, (2) acute poisoning due to contact with fresh oil, (3) lowering of tolerance to other stress due to the incorporation of sublethal amounts of petroleum components into body tissues, (4) nutritional stress through damage to food sources, and (5) inflammation or infection and difficulty eating due to oil sticking to the sensory hairs around their mouths (Preen, 1989, in Sadiq and McCain, 1993; Australian Maritime Safety Authority, 2003). For an endangered population whose environment is already under great pressure, even a localized incident could be significant (St. Aubin and Lounsbury, 1990). Spilled oil might affect the quality or availability of aquatic vegetation, including seagrasses, upon which manatees feed. Also, since this species is known to be easily struck by passing boats, manatees may be at risk for injury if cleanup activities were happening in their habitat.

As noted previously, BOEMRE has consulted with NMFS and FWS regarding the effects to ESA-listed marine mammal species from spilled oil (USDOC, NMFS, 2007b; USDOI, FWS, 2007). These previous consultations concluded that the proposed lease sale and associated activities (1) were not likely to affect ESA-listed species or habitat in the GOM under FWS jurisdiction (namely manatees and nesting sea turtles) and (2) were not likely to jeopardize the continued existence of ESA-listed species under NMFS jurisdiction or destroy or adversely modify designated critical habitat (mainly Gulf sturgeon, cetaceans and sea turtles in the water). The NMFS Biological Opinion did find that spilled oil resulting from the proposed lease sales (WPA Lease Sale 218 included) could cause up to 11 nonlethal takes of sperm whales over the 40-year lifetime of the proposed lease sale. However, NMFS did not include an incidental take statement for sperm whales given an oil spill is an "otherwise unlawful activity." Incidental take, as defined at 50 CFR 402.02, refers only to takings that result from an otherwise lawful activity. The Clean Water Act (33 U.S.C. 1251 et seq.), as amended by the Oil Pollution Act of 1990 (33 U.S.C. 2701 et seq.), prohibits discharges of harmful quantities of oil, as defined at 40 CFR 110.3, into waters of the United States. Therefore, even though the Biological Opinion considered the effects on listed species by oil spills that may result from proposed WPA Lease Sale 218, those takings that would result from an unlawful activity (i.e., oil spills) are not specified in this Incidental Take Statement and have no protective coverage under Section 7(o)(2) of the ESA. (As discussed previously, BOEMRE has requested reinitiation of ESA consultation with both NMFS and FWS. Pending completion of this reinitiated consultation, BOEMRE is working with both agencies to develop an interim coordination policy and the current consultation remains in effect.)

Summary and Conclusion

The analysis of the effects from accidental spills (non-catastrophic) on marine mammals remains unchanged from what was concluded in the Multisale EIS and the 2009-2012 Supplemental EIS. Impacts on marine mammals from smaller accidental events are likely to affect individual marine mammals in the spill area, as described above and within the Multisale EIS and the 2009-2012 Supplemental EIS, but are unlikely to rise to the level of population effects (or significance) given the size and scope of such spills. Further, the potential remains for smaller accidental spills to occur in the proposed action area, regardless of any alternative selected under this Supplemental EIS, given there are 1,394 active leases already in this area with either ongoing or the potential for exploration, drilling, and production activities.

For low-probability catastrophic spills, the Multisale EIS, 2009-2012 Supplemental EIS, and **Appendix B** of this Supplemental EIS conclude that there is a potential for a low-probability catastrophic event to result in significant, population level effects on affected marine mammal species. The BOEMRE continues to concur with the conclusions from these analyses.

The BOEMRE concludes that there is incomplete or unavailable information that may lead to reasonably foreseeable significant adverse impacts to marine mammals from accidental events. For example, there is incomplete information on impacts to marine mammal populations from the DWH event. Relevant data on the status of and impacts to marine mammal populations from the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeline contemplated in this Supplemental EIS, regardless of the cost or resources needed. In the absence of this information, BOEMRE subject-matter experts have used what scientifically credible information that is available and applied using accepted scientific methodologies. The BOEMRE does not, however, believe this incomplete information is essential to make a reasoned choice among the alternatives, primarily because activities that could result in an accidental spill in the WPA would be ongoing whether or not the lease sale under the proposed action of this Supplemental EIS occurred. At present, there are 1,394 active leases in the proposed action area that are engaged, or have the potential to be engaged, in drilling and/or production activities that could theoretically result in an accidental spill. Given these existing leases and this ongoing activity, any incomplete information that may lead to reasonably foreseeable significant adverse impacts to marine mammals is not needed to make a reasoned choice among the alternatives, including the No Action alternative.

4.1.1.10.4. Cumulative Impacts

A detailed impact analysis of marine mammals for proposed WPA Lease Sale 218 can be found in Chapter 4.5.5 of the Multisale EIS. Impact analyses for the 181 South Area that includes any new information since publication of the Multisale EIS is presented in Chapter 4.1.6.4 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

The major potential impact-producing factors affecting protected marine mammals in the GOM as a result of cumulative OCS energy-related activities include marine debris, contaminant spills and spill-response activities, vessel traffic, noise, seismic surveys, and explosive structure removals. Non-OCS energy-related activities that may affect marine mammal populations include vessel traffic and related noise (including from commercial shipping, research vessels), military operations, commercial fishing, and pollution. A detailed cumulative impact analysis of marine mammals for proposed WPA Lease Sale 218 can be found in Chapter 4.5.5 of the Multisale EIS and Chapter 4.1.6.4 of the 2009-2012 Supplemental EIS. There is no new information regarding effects of non-OCS energy-related activities since the prior NEPA analyses that would alter the conclusions contained in the Multisale EIS and 2009-

2012 Supplemental EIS. Activities considered under the cumulative scenario could affect protected cetaceans and sirenians (manatees).

The cumulative impact on marine mammals is expected to result in a number of chronic and sporadic sublethal effects (i.e., behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources (Harvey and Dahlheim, 1994). Disturbance (noise from vessel traffic and drilling operations) and/or exposure to sublethal levels of toxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them more vulnerable to parasites and diseases that normally would not be fatal (Harvey and Dahlheim, 1994). The net result of any disturbance will depend upon the size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). As discussed in **Appendix B**, a low-probability, large-scale catastrophic event could have population-level effects on marine mammals.

The effects of the proposed action, when viewed in light of the effects associated with other past, present, and reasonably foreseeable future activities, may result in greater impacts to marine mammals than before the DWH event; however, the magnitude of those effects cannot yet be determined. Nonetheless, operators are required to follow all applicable lease stipulations and regulations, as clarified by NTL's, to minimize these potential interactions and impacts. The operator's reaffirmed compliance with NTL 2007-G04 ("Vessel-Strike Avoidance") and NTL 2007-G03 ("Marine Trash and Debris"), as well as the limited scope, timing, and geographic location of the proposed action, would result in negligible effects from the proposed drilling activities on marine mammals. In addition, NTL 2007-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," minimizes the potential of harm from seismic operations to marine mammals. These mitigations include onboard observers, airgun shut-downs for whales in the exclusion zone, ramp-up procedures, and the use of a minimum sound source. Therefore, no significant cumulative impacts to marine mammals would be expected as a result of the proposed exploration activities when added to the impacts of past, present, or reasonably foreseeable oil and gas development in the area, as well as other ongoing activities in the area.

Summary and Conclusion

The BOEMRE has considered this assessment and reexamined the cumulative analysis for marine mammals presented in the Multisale EIS, the 2009-2012 Supplemental EIS, and the cited new information. Based on this evaluation, conclusions in these analyses on effects to marine mammals remain unchanged in regards to Routine Activities (no potential for significant adverse effects) and Accidental Spills (potential for significant adverse effects).

Unavailable information on the effects to marine mammals from the DWH and UME events (and thus changes to the marine mammal baseline in the Affected Environment) makes an understanding of the cumulative effects less clear. Here, BOEMRE concludes that the unavailable information from these events may be relevant to foreseeable significant adverse impacts to marine mammals. Relevant data on the status of marine mammal populations after the UME and DWH events may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. For example, even 20 years after the *Exxon Valdez* spill, long-term impacts to marine mammal populations are still being investigated. Therefore, it is not possible for BOEMRE to obtain this information within the timeline contemplated in this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEMRE subject-matter experts have used available scientifically credible evidence in this analysis and based upon accepted methods and approaches.

Nevertheless, a complete understanding of the missing information is not essential to a reasoned choice among the alternatives for this Supplemental EIS (including the No Action and Action Alternatives) for three main reasons:

(1) There are 1,394 active leases in the WPA with ongoing (or the potential for) exploration, drilling, and production activities. In addition, non-OCS energy-related activities will continue to occur in the WPA irrespective of this proposed lease sale

(i.e., fishing, military activities, and scientific research). The potential for effects from changes to the Affected Environment (post-DWH), Routine Activities, Accidental Spills (including low-probability catastrophic spills), and Cumulative Effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on marine mammals from either smaller accidental events or low-probability catastrophic events will remain the same.

(2) As discussed in the above sections, some marine mammal populations in the WPA do not generally travel throughout areas affected by DWH spilled oil and would not be subject to a changed baseline or cumulative effects from the DWH event (e.g., coastal bottlenose dolphins resident in the WPA). Other marine mammals, such as Bryde's whales and manatees, although potentially affected by the DWH event do not typically occur in the WPA.

(3) Other wide-ranging populations of marine mammals (e.g., sperm whales and killer whales) that may occur in the WPA and within areas affected by the spill are unlikely to have experienced population level effects from the DWH event given their wide-ranging distribution and behaviors.

Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that activities from the pre-existing OCS program are significantly impacting marine mammal populations. Therefore, in light of the above analysis on the proposed action and its impacts, the incremental effect of the proposed action on marine mammal populations is not expected to be significant when compared with non-OCS energy-related activities.

4.1.1.11. Sea Turtles

The BOEMRE has reexamined the analysis for the five sea turtle species that inhabit the Gulf of Mexico in the Multisale EIS and the 2009-2012 Supplemental EIS based on the additional information presented below and in consideration of the DWH event. The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS and the 2009-2012 Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

4.1.1.11.1. Description of the Affected Environment

A detailed description of sea turtles can be found in Chapter 3.2.4 of the Multisale EIS. Any new information since the publication of the Multisale EIS is presented in Chapter 4.1.7 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Five sea turtles are known to inhabit the waters of the GOM (Pritchard, 1997): the leatherback (endangered, listed June 2, 1970); green turtle (breeding colony populations in Florida and on the Pacific Coast of Mexico are listed as endangered; all others are listed as threatened; listed July 28, 1978); hawksbill (endangered, listed June 2, 1970); Kemp's ridley (endangered, listed December 2, 1970); and loggerhead (threatened, listed July 28, 1978). These five species are all highly migratory (**Table 4-3**). Individual animals make migrations into nearshore waters as well as other areas of the North Atlantic Ocean, Gulf of Mexico, and the Caribbean Sea. Although migratory, these migration patterns are not well defined. All five species of sea turtles found in the Gulf of Mexico have been federally listed as endangered or threatened since the 1970's. There is currently no critical habitat designated in the Gulf of Mexico or along the Gulf Coast. On February 17, 2010, NMFS and FWS were jointly petitioned to designate critical habitat for Kemp's ridley sea turtles for nesting beaches along the Texas coast and for marine habitats in the Gulf of Mexico and Atlantic Ocean. The NMFS is currently reviewing the petition.

In August 2007, FWS and NMFS published 5-year status reviews for federally listed sea turtles in the Gulf of Mexico (USDOC, NMFS and USDOI, FWS, 2007a-e). A 5-year review is an ESA-mandated process that is conducted to ensure the listing classification of a species as either threatened or endangered is still accurate. Both agencies share jurisdiction for federally listed sea turtles and jointly conducted the reviews. After reviewing all of the best scientific and commercially available information and data, the agencies' biologists recommended that the current listing classification for the five sea turtle species remain unchanged.

Natural phenomenon, such as tropical storms and hurricanes, are impossible to predict, but they will occur with frequency in the Gulf of Mexico. Generally, the offshore species and the offshore habitat are not expected to be severely affected in the long term. However, when species occupy more nearshore habitats and use nearshore habitats for nesting, they may suffer more long-term impacts. Several major hurricanes have hit the Gulf Coast in the last several years. Storm impacts including loss of nesting habitat, increased marine debris, and spilled pollutants can be detrimental to sea turtles. Impacts from the storms to nesting activity can be hard to assess. Hurricane Ike in 2008 occurred in areas used by sea turtles for nesting. Hurricane Ike hit the northern Texas coast where Kemp's ridley sea turtles have begun nesting in recent years after decades of nest and hatchling relocation from beaches in Mexico. The massive amount of storm debris from Hurricane Ike littered beaches well into south Texas, including Padre Island, which is a very important Kemp's ridley nesting habitat. Both the washing away of sand beaches and the proliferation of debris on nesting beaches can post major barriers to successful nesting. Although the beach cleanup in Texas will be a long process, the 2009 nesting season showed that the turtles returned despite the prior year's destruction, with 197 Kemp's ridley nests counted (USDOI, NPS, 2009). This was the highest number of nests counted in Texas to date, barely topping the previous record of 195 nests in 2008. The late August/September timeframe of most of the recent Gulf of Mexico storms was toward the end of the sea turtle nesting season (generally April/May to October). Many nests had successfully hatched prior to storm damage (Florida Fish and Wildlife Conservation Commission, 2008). Nests documented for 2010 on the Texas coast are from Kemp's ridley sea turtles (141 nests), loggerhead sea turtles (9 nests), and green sea turtles (5 nests) (USDOI, NPS, 2010).

Leatherback Sea Turtle

The leatherback is the most abundant sea turtle in waters over the northern Gulf of Mexico continental slope (Mullin and Hoggard, 2000). The leatherback sea turtle is listed as endangered. Leatherbacks appear to spatially use both continental shelf and slope habitats in the Gulf of Mexico (Fritts et al., 1983; Collard, 1990; Davis and Fargion, 1996). Surveys suggest that the region from Mississippi Canyon to De Soto Canyon, especially near the shelf edge, appears to be an important habitat for leatherbacks (Mullin and Hoggard, 2000). Leatherbacks have been frequently sighted in the Gulf of Mexico during both summer and winter (Mullin and Hoggard, 2000).

On the Atlantic side of Florida, an increase in leatherback nesting numbers from 98 nests in 1988 to 800-900 nests per season in the early 2000's has been recorded. There has been a substantial increase in leatherback nesting in Florida since 1989 (USDOC, NMFS and USDOI, FWS, 2007a). As of 2007, there were no confirmed sightings of leatherbacks coming ashore to nest on beaches adjacent to WPA in Texas since 1930 (USDOI, FWS, 2007). Although nesting is relatively rare on the western Gulf of Mexico beaches, leatherbacks occur in Gulf of Mexico waters, including the WPA. The 2007 FWS Biological Opinion stated, "There have been no confirmed sightings of leatherbacks coming ashore to nest within the WPA or CPA since 1930 in Texas. Therefore, the Service [FWS] has determined that the proposed project will not affect nesting leatherback sea turtles" (USDOC, NMFS, 2007b). However, there was a recorded nest site in Texas during the 2008 season (USDOI, NPS, 2008). Satellite telemetry and tag returns have shown that some of the leatherbacks present in the Gulf of Mexico were tagged at nesting beaches in Costa Rica and Panama (USDOC, NMFS and USDOI, FWS, 2007a).

Critical habitat for the leatherback includes the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands. There is no critical habitat designation for the leatherback sea turtle in the Gulf of Mexico. Ongoing threats to leatherbacks include ingestion of marine debris, poaching of eggs and animals, and entanglement in longline fishing gear.

Green Sea Turtle

All green sea turtle populations are listed as threatened except for the breeding populations of Florida and the Pacific Coast of Mexico, which are endangered. Green sea turtles are found throughout the GOM and are known to nest on GOM beaches, but in very small numbers (USDOC, NMFS and USDOI, FWS, 2007b). Reports of green turtles nesting along the Gulf Coast are infrequent, and Padre Island National Seashore and South Padre Island are the only locations on the Texas coast where green turtle nesting has been documented (1-5 nests per year) (USDOI, NPS, 2011).

After emerging from the nest, hatchlings swim to offshore areas, where they are believed to live for several years, feeding close to the surface on a variety of pelagic plants and animals. Once the juveniles reach a certain age/size range, they leave the pelagic habitat and travel to nearshore foraging grounds. Once they move to these nearshore benthic habitats, adult green turtles are almost exclusively herbivores, feeding on seagrasses and algae. Adult females migrate from foraging areas to mainland or island nesting beaches and may travel hundreds or thousands of kilometers each way (USDOI, FWS, 2007).

The principal cause of past declines and extirpations of green turtle assemblages has been the over-exploitation of green turtles for eggs and meat. Significant threats on green turtle nesting beaches in the region include beach armoring, erosion control, artificial lighting, and disturbance. Armoring of beaches (e.g., seawalls, revetments, rip-rap, sandbags, and sand fences) in Florida, which is meant to protect developed property, is increasing and has been shown to discourage nesting even when armoring structures do not completely block access to nesting habitat (Mosier, 1998).

Hawksbill Sea Turtle

Hawksbill sea turtles were once abundant in tropical and subtropical regions. Pelagic-size individuals and small juveniles are not uncommon and are believed to be animals dispersing from nesting beaches in the Yucatán Peninsula of Mexico and farther south in the Caribbean (Amos, 1989). The hawksbill turtle is listed as endangered and is considered critically endangered by the International Union for the Conservation of Nature based on global population declines of over 80 percent during the last three generations (105 years) (Meylan and Donnelly, 1999).

Hawksbill sea turtles are highly migratory and use a wide range of habitats during their lifetime. As with most sea turtle species, hatchlings and early juveniles are often found in association with oceanic *Sargassum* floats. As later juveniles, they move nearshore for feeding habitat and may associate with the same feeding locality for more than a decade (Musick and Limpus, 1997). In the continental U.S., hawksbills are found primarily in Florida and Texas, though they have been recorded in all the Gulf States and along the east coast as far north as Massachusetts. The Atlantic Coast of Florida is the only area in the U.S. where hawksbills nest on a regular basis.

Hawksbills are threatened by all the factors that threaten other marine turtles, including exploitation for meat, eggs, and the curio trade; loss or degradation of nesting and foraging habitats; increased human presence; nest depredation; oil pollution; incidental capture in fishing gear; ingestion of and entanglement in marine debris; and boat collisions (Lutcavage et al., 1997; Meylan and Ehrenfeld, 2000). The primary cause of hawksbill decline has been attributed to centuries of exploitation for tortoiseshell, the beautifully patterned scales that cover the turtle's shell (Parsons, 1972). Another manmade factor that affects hawksbills in foraging areas and on nesting beaches is global climate change (USDOC, NMFS and USDOI, FWS, 2007c).

Kemp's Ridley Sea Turtle

The nearshore waters of the GOM are believed to provide important developmental habitat for juvenile Kemp's ridley and loggerhead sea turtles. Ogren (1989) suggests that the Gulf Coast, from Port Aransas, Texas, through Cedar Key, Florida, represents the primary habitat for subadult ridleys in the northern Gulf of Mexico. Internationally, the Kemp's ridley is considered the most endangered sea turtle. There is no designated critical habitat for the Kemp's ridley sea turtle; however, on February 17, 2010, NMFS and FWS were jointly petitioned to designate critical habitat for Kemp's ridley sea turtles for nesting beaches along the Texas coast and for marine habitats in the Gulf of Mexico and Atlantic Ocean. The NMFS is currently reviewing the petition.

The species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. Kemp's ridleys nest in daytime aggregations known as arribadas, primarily at Rancho Nuevo, a stretch of beach in Mexico, Tamaulipas State. A 2007 arribada at Rancho Nuevo included over 4,000 turtles over a 3-day period (USDOC, NMFS and USDOI, FWS, 2007d). On the Texas coast, 251 Kemp's ridley nests were recorded from 2002 to 2006. For the 2007 nesting season, 128 nests had been recorded. For 2008, the nests in Texas totaled 195; for 2009, there were 197 nests; and for 2010, there were 141 nests (USDOI, NPS, 2011). Kemp's ridleys are nesting in the Padre Island National Seashore, and NPS believes that hatchlings and subadults spend some time in the northern GOM, particularly during the summer months.

Of the seven extant species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Many threats to the future of the species remain, including interactions with fishery gear, marine pollution, foraging habitat destruction, illegal poaching of nests, and the potential threats to nesting beaches from such sources as global climate change, development, and tourism pressures (USDOC, NOAA, 2011b).

Loggerhead Sea Turtle

Loggerhead sea turtles are considered a threatened species. In the GOM, loggerheads nest primarily in southwest Florida with minimal nesting outside of this range westward to Texas. Loggerhead turtles have been primarily sighted in waters over the continental shelf, although many surface sightings of this species have also been made over the outer slope beyond the 1,000-m (3,281-ft) isobath. Hatchlings emerge from the nest and swim away from land for several days. Offshore, they reside for months in the oceanic zone in *Sargassum* floats, generally along the Loop Current and the Gulf Coast of Florida. Somewhere between 7 and 12 years old, oceanic juveniles migrate to nearshore coastal areas to mature into adults. These nearshore waters become important foraging and migratory habitat for juveniles and adults. Juveniles may also spend time in bays, sounds, and estuaries. Adult loggerheads are known to make extensive migrations between foraging areas and nesting beaches. During nonnesting years, adult females from U.S. beaches are distributed in waters off the eastern U.S. and throughout the Gulf of Mexico, Bahamas, Greater Antilles, and Yucatán (Conant et al., 2009).

Ongoing threats to the western Atlantic loggerhead populations include incidental takes from dredging, commercial trawling, longline fisheries, and gillnet fisheries; loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; nest predation by native and nonnative predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and disease (USDOC, NOAA, 2011b).

In the past decade, a 39.5 percent decline in the annual number of nests has been reported (USDOC, NMFS and USDOI, FWS, 2007e). Texas reported two loggerhead nests in 2006 and six in 2007. For 2008, there were three nests reported in Texas; and for 2010, nine nests were reported.

The NMFS has issued a proposed rule to list nine distinct population segments of loggerhead sea turtles under the ESA (76 FR 15932). The comment period is set to close on September 16, 2011, but none of the distinct population segments are located in the Gulf of Mexico.

Recent Section 7 Endangered Species Act Consultation

As mandated by the ESA, BOEMRE consulted with NMFS and FWS on possible and potential impacts from the WPA proposed action on endangered/threatened species and designated critical habitat under their jurisdiction. A biological assessment was prepared for each consultation. The action area analyzed in the biological assessments included the lease sale area addressed in this Supplemental EIS.

The consultation with the FWS concluded that activities occurring as a result of the proposed WPA action may affect nesting and hatchlings of the threatened loggerhead and endangered Kemp's ridley; however, no direct loss of habitat is anticipated. The anticipated effects from the major impact-producing factors are sublethal, causing discountable insignificant effects. The consultation went on to identify an oil spill reaching sea turtle nesting habitat during the nesting season as the greatest threat to sea turtles. However, FWS concurred, based on the probabilities identified by this Agency of a spill reaching nesting habitat at the time (0.5% to 9%), that the potential for contact was greatly reduced. Overall, FWS concurred that the proposed action (again of which this Supplemental EIS is a segment) would not adversely affect nesting and hatchling loggerhead or Kemp's ridley turtles (USDOI, FWS, 2007).

The formal ESA consultation with NMFS (the agency with oversight on sea turtles in the water) was concluded with receipt of the Biological Opinion on July 3, 2007 (USDOC, NMFS, 2007b). The Biological Opinion concludes that the proposed lease sale and associated activities in the Gulf of Mexico under the current 5-Year Program are not likely to jeopardize the continued existence of threatened and endangered species under NMFS jurisdiction or destroy or adversely modify designated critical habitat.

Following the DWH event, on July 30, 2010, BOEMRE requested reinitiation of ESA consultation with both NMFS and FWS. The NMFS responded with a letter to BOEMRE on September 24, 2010. The FWS responded with a letter to BOEMRE on September 27, 2010. The reinitiated consultations are not complete at this time, although BOEMRE is in discussions with both agencies. In the meantime, the current consultation remains in effect and recognizes that BOEMRE-required mitigations and other reasonable and prudent measures should reduce the likelihood of impacts from BOEMRE-authorized activities. Further, BOEMRE has determined, under Section 7(d) of the ESA, that the proposed action of this Supplemental EIS is not an irreversible or irretrievable commitment of resources that has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures. The BOEMRE is also developing an interim coordination program with NMFS and FWS while consultation is ongoing.

***Deepwater Horizon* Event**

The DWH event and resulting oil spill in Mississippi Canyon Block 252 and related spill-response activities (including use of dispersants) have impacted sea turtles that have come into contact with oil and remediation efforts. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). For the latest available information on oiled or affected sea turtles documented in the area, event response activities, and daily maps of the current location of spilled oil, see RestoreTheGulf.gov (2010b, last accessed June 29, 2011). The list below summarizes sea turtles collected by date obtained from the consolidated numbers of collected fish and wildlife that have been reported to the Unified Area Command from FWS, NOAA, incident area commands, rehabilitation centers, and other authorized sources operating within the DWH event impact area through April 12, 2011.

According to the Consolidated Fish and Wildlife Collection Report after the DWH event, 1,146 sea turtles have been collected (536 alive and 613 deceased as of April 20, 2011). Of these, 201 were greens, 16 Hawksbills, 809 Kemp's ridleys, 88 loggerheads, and the remaining 32 unknown (USDOC, NMFS, 2011c). The vast majority of sea turtles collected either alive or dead were found well east of the Louisiana/Texas border and the eastern edge of the WPA (USDOC, NMFS, 2011d). However, due to low detection rates of carcasses in prior events, it is possible that the number of deaths of sea turtles is underestimated (Epperly et al., 1996). It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the DWH oil spill.

As a preventative measure, NMFS and FWS, as part of the DWH oil-response effort, translocated a number of sea turtle nests and eggs that were located on beaches affected or potentially affected by spilled oil. According to the latest information on the NMFS stranding network website (USDOC, NMFS, 2011c), a total of 274 nests were translocated from Gulf of Mexico beaches to the east coast of Florida. These nests were mainly for hatchlings that would enter waters off Alabama and Florida's northwest Gulf Coast. Of these, 4 were from green turtles, 5 from Kemp's ridley and 265 from loggerheads, as indicated in the table below. The translocation effort ended August 19, 2010, at the time when biologists determined that risks to hatchlings emerging from beaches and entering waters off Alabama and Florida's northwest Gulf Coast had diminished significantly and that the risks of translocating nests during late incubation to the east coast of Florida outweighed the risks of letting hatchlings emerge into the Gulf of Mexico. The hatchlings resulting from the translocations were all released as of September 9, 2010.

Final Data on Nesting Translocation
(updated on April 19, 2011)

Species	Translocated Nests	Hatchlings Released
Green turtle (*Chelonia mydas*)	4	455
Kemp's ridley turtle (*Lepidochelys kempii*)	5	125
Loggerhead turtle (*Caretta caretta*)	265*	14,216

*Does not include one nest that included a single hatchling and no eggs.
Note: All data is preliminary.
Source: USDOC, NMFS, 2011c.

As of August 3, 2010, in open water, there was no evidence that sea turtles were still being exposed to chemicals from the DWH event (OSAT, 2010). This report states, "Since 3 August [2010], no exceedances of the aquatic life benchmark for PAH's in water that were consistent with MC252 oil." It is likely that there were effects on individual sea turtles in the vicinity of the DWH spill caused by spilled oil and/or response activities. Depending upon the species' sensitivity and/or low resiliency, individual sea turtles may be experiencing residual effects provided sufficient exposure. Further, it is uncertain whether or how many sea turtle individuals affected by the spill would be present in the WPA when activities first occur as a result of this proposed lease sale. Without any further data than what exist from NOAA, it is impossible to determine if the spill has led to population-level effects or if sea turtles are experiencing chronic effects or persistent adverse impacts from the spill at the population level. Information is still being gathered to develop a more complete picture of impacts and the length of time for any changed baseline conditions to return to pre-spill conditions (see "Sea Turtle Resources in the Western Planning Area" below). It is also important to note that evaluations have not yet confirmed the cause of death, including whether or not related to the DWH oil spill.

Sea Turtle Strandings in the Gulf of Mexico

Since March 15, 2011, a notable increase in sea turtle strandings has occurred in the northern Gulf of Mexico, primarily in Mississippi. While turtle strandings in this region typically increase in the spring, the recent increase is a cause for concern. The Sea Turtle Stranding and Salvage Network (STSSN) is monitoring and investigating this increase. The network encompasses the coastal areas of the 18 states from Maine through Texas and includes portions of the U.S. Caribbean. There are many possible reasons for the increase in strandings in the northern Gulf of Mexico, both natural and human caused (USDOC, NMFS, 2011e). No visible external or internal oil was observed in these animals. Investigation is ongoing but at this time NMFS has not identified any information regarding potential strandings in Texas.

Sea Turtle Resources in the Western Planning Area

The final determinations on damages to sea turtle resources from the DWH event will ultimately be made through the NRDA process. The DWH event will ultimately allow a better understanding of any realized effects from such a low-probability catastrophic spill. However, the best available information on impacts to sea turtles does not yet provide a complete understanding of the effects of the oil spilled and active response/cleanup activities from the DWH event on sea turtles as a whole in the GOM and whether these impacts reach a population level. There is also an incomplete understanding of the potential for population-level impacts from the ongoing increased stranding event. Here, BOEMRE concludes that the unavailable information from these events may be relevant to foreseeable significant adverse impacts to sea turtles in the WPA. Relevant data on the status of sea turtle populations after the increased stranding during the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeframe contemplated in this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEMRE subject-matter experts have used available scientifically credible evidence in this analysis and based upon accepted methods and approaches.

Nevertheless, a complete understanding of the missing information is not essential to a reasoned choice among alternatives for this Supplemental EIS (including the No Action and Action Alternatives) for two main reasons:

(1) There are 1,394 active leases in the WPA with ongoing (or the potential for) exploration, drilling, and production activities. In addition, non-OCS energy-related activities will continue to occur in the WPA irrespective of this proposed lease sale (i.e., fishing, military activities, scientific research, and shoreline development). The potential for effects from changes to the Affected Environment (post-DWH), Routine Activities, Accidental Spills (including low-probability catastrophic spills), and Cumulative Effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on sea turtles from either smaller accidental events or low-probability catastrophic events will remain the same.

(2) All wide-ranging populations of sea turtles that may occur in the WPA and within areas affected by the spill are unlikely to have experienced population-level effects from the DWH event given their wide-ranging distribution and behaviors.

Further, the analyses in the Multisale EIS, the 2009-2012 Supplemental EIS, and this Supplemental EIS (**Chapter 4.1.1.11.1** [Affected Environment], **Chapter 4.1.1.11.2** [Accidental Spills], and **Appendix B**) conclude that there is a potential for low-probability catastrophic events to result in significant, population-level effects on affected sea turtle species. The BOEMRE continues to agree with these conclusions irrespective of any incomplete information, changes to the existing environment from the DWH event, or even the effectiveness of implementation of the improved post-DWH safety and oil-spill-response requirements.

4.1.1.11.2. Impacts of Routine Events

Background/Introduction

A detailed impact analysis of sea turtles for proposed WPA Lease Sale 218 can be found in Chapter 4.2.1.1.6 of the Multisale EIS and in Chapter 4.1.7.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

Routine activities resulting from the WPA proposed action have the potential to harm sea turtles, although this potential is unlikely to rise to a level of significance. The major impact-producing factors resulting from the routine activities associated with the WPA proposed action that may affect loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles include the degradation of water quality resulting from operational discharges; noise generated by helicopter and vessel traffic, platforms, drillships, and seismic exploration; vessel collisions; and marine debris generated by service vessels and OCS facilities.

Contaminants in waste discharges and drilling muds might indirectly affect sea turtles through food-chain biomagnification, but there is uncertainty concerning the possible effects. Most operational discharges are diluted and dispersed when released in offshore areas and are considered to have sublethal effects (NRC, 1983; API, 1989; Kennicutt, 1995; Kennicutt et al., 1996). Any potential impacts from drilling fluids would be indirect, either as a result of impacts to prey species or possibly through ingestion via the food chain (Neff et al., 1989). Impacts from water degradation are expected to be negligible, due to rapid dilution of the discharges which are regulated by NPDES permits, and due to the wide-ranging habits of sea turtle species in the Gulf of Mexico.

Another impact-producing factor associated with the WPA proposed action that could affect ESA-listed sea turtles is impacts from vessel noise and vessel collisions. The dominant source of noise from vessels is propeller operation, and the intensity of this noise is largely related to ship size and speed. Vessel noise from activities resulting from the proposed action would produce low levels of noise, generally in the 150- to 170-dB re 1 µPa-m at frequencies below 1,000 Hz. Vessel noise is transitory and generally does not propagate at great distances from the vessel. Also, available information indicates that sea turtles are not thought to rely on acoustics. As a result, the NMFS 2007 Biological Opinion concluded that effects to sea turtles from vessel noise are "discountable" (USDOC, NMFS, 2007b).

Drilling activities would produce sounds transmitted into the water that could be intermittent, sudden, and at times could be high intensity as operations take place. However, sea turtles are not expected to be impacted by this disturbance because NMFS, in their 2007 Biological Opinion, determined that "drilling is not expected to produce amplitudes sufficient to cause hearing or behavioral effects to sea turtles or sperm whales; therefore, these effects are insignificant."

Sea turtles spend at least 3-6 percent of their time at the surface for respiration and perhaps as much as 26 percent of their time at the surface for basking, feeding, orientation, and mating (Lutcavage et al., 1997). Data show that collisions with all types of commercial and recreational vessels are a cause of sea turtle mortality in the GOM (Lutcavage et al., 1997). Stranding data for the U.S. Gulf and Atlantic Coasts, Puerto Rico, and the U.S. Virgin Islands show that, between 1986 and 1993, about 9 percent of living and dead stranded sea turtles had boat strike injuries (Lutcavage et al., 1997). Vessel-related injuries were noted in 13 percent of stranded turtles examined from the GOM and the Atlantic during 1993 (Teas, 1994), but this figure includes those that may have been struck by boats post-mortem. Large numbers of loggerheads and 5-50 Kemp's ridley turtles are estimated to be killed by vessel traffic per year in the U.S. (NRC, 1990; Lutcavage et al., 1997).

There have been no documented sea turtle collisions with drilling and service vessels in the GOM; however, collisions with small or submerged sea turtles may go undetected. Based on sea turtle density estimates in the GOM, the encounter rates between sea turtles and vessels would be expected to be greater in water depths less than 200 m (656 ft) (USDOC, NMFS, 2007b). To further minimize the potential for vessel strikes, BOEMRE issued NTL 2007-G04, which clarifies 30 CFR 250.282 and provides NMFS guidelines for monitoring procedures related to vessel strike avoidance measures for sea turtles and other protected species. With implementation of these measures and the avoidance of potential strikes from OCS vessels, the NMFS 2007 Biological Opinion concluded that the risk of collisions between oil- and gas-related vessels (including those for G&G, drilling, production, decommissioning, and transport) and sea turtles is appreciably reduced, but strikes may still occur. The BOEMRE monitors for any takes that have occurred as a result of vessel strikes and also requires that any operator immediately report the striking of any animal (30 CFR 250.282 and NTL 2007-G04).

To date, there have been no reported strikes of sea turtles by drilling vessels. Given the scope, timing, and transitory nature of the WPA proposed action and with this established mitigation, effects to sea turtles from drilling vessel collisions is expected to be negligible.

Chronic sublethal effects (e.g., stress), resulting in persistent physiological or behavioral changes and/or avoidance of impacted areas from noise disturbance such as G&G activities, could cause declines in survival or fecundity and could result in population declines; however, such declines are not expected. Seismic operations have the potential to harm sea turtles in close proximity to firing airgun arrays, especially if they are directly beneath airguns when surveying begins. The Protected Species Stipulation and NTL 2007-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," minimize the potential of harm from seismic operations to sea turtles. These mitigations include onboard observers, airgun shut-downs for whales in the exclusion zone, ramp-up procedures, and the use of a minimum sound source.

The BOEMRE published a Programmatic EA on decommissioning operations (USDOI, MMS, 2005) that, in part, addresses the potential impacts of explosive- and nonexplosive-severance activities on OCS energy related resources, particularly upon marine mammals and sea turtles. Pursuant to 30 CFR 250 Subpart Q, operators must obtain a permit from BOEMRE before beginning any platform removal or well-severance activities. During the review of the permit applications, terms and conditions of the applicable NMFS Biological Opinion/Incidental Take Statement are implemented for the protection of marine protected species and to reduce the possible impacts from any potential activities resulting from the proposed lease sale.

In 30 CFR 250 Subpart B, BOEMRE requires operators of Federal oil and gas leases to meet the requirements of ESA. The regulations outline the environmental, monitoring, and mitigation information that operators must submit with plans for exploration, development, and production. This regulation requires OCS energy-related activities to be conducted in a manner that is consistent with the provisions of the ESA. Actual sea turtle impacts from explosive removals in recent years have been small. The updated pre- and post-detonation mitigations should ensure that injuries remain extremely rare.

Greatly improved handling of waste and trash by industry, along with the annual awareness training required by the marine debris mitigations, is decreasing the plastics in the ocean attributable to OCS energy related activities and is minimizing the devastating effects on sea turtles. Many types of plastic materials end up as solid waste during drilling and production operations. Some of this material is accidentally lost overboard where sea turtles could consume it or become entangled in it. The incidental ingestion of marine debris and entanglement could adversely affect sea turtles. The BOEMRE proposes compliance with the guidelines provided in NTL 2007-G03, "Marine Trash and Debris Awareness and Elimination," which appreciably reduces the likelihood of sea turtles encountering marine debris from the proposed activity. The routine activities of the WPA proposed action are unlikely to have significant adverse effects on the size and recovery of any sea turtle species or populations in the Gulf of Mexico.

Summary and Conclusion

In this Supplemental EIS, BOEMRE has reexamined the analysis for sea turtles presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and has considered the recent reports cited above and other new information. Because of the mitigations described in the above analysis, routine activities (e.g., operational discharges, noise, vessel traffic, and marine debris) related to the WPA proposed action are not expected to have long-term adverse effects on the size and productivity of any sea turtle species or populations in the northern GOM. Lethal effects could occur from chance collisions with OCS service vessels or ingestion of accidentally released plastic materials from OCS vessels and facilities. However, there have been no reports to date on such incidences. Most routine OCS energy-related activities are then expected to have sublethal effects that are not expected to rise to the level of significance.

Although there will always be some level of incomplete information on the effects from routine activities under this proposed action on sea turtles, there is credible scientific information, applied using acceptable scientific methodologies, to support the conclusion that any realized impacts would be sublethal in nature and not in themselves rise to the level of reasonably foreseeable significant adverse (population level) effects. Also, routine activities will be ongoing in the proposed action area (WPA) as a result of existing leases and related activities. (In the WPA, there are 1,394 active leases [USDOI, BOEMRE, 2011]). Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that routine activities from the pre-existing OCS program are significantly impacting sea turtle populations. Therefore, a full understanding of any incomplete or unavailable information on the effects of routine activities is not essential to make a reasoned choice among the alternatives.

4.1.1.11.3. Impacts of Accidental Events

A detailed impact analysis of sea turtles for proposed WPA Lease Sale 218 can be found in Chapter 4.4.6 of the Multisale EIS and in Chapter 4.1.7.3 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared. This section treats both the expected accidental spill as well as the low-probability, large-volume spill with catastrophic events. Further, general analyses of a catastrophic event in the GOM can also be found in **Appendix B**.

Proposed Action Analysis

Accidental activities resulting from proposed WPA Lease Sale 218 have the potential to harm sea turtles. The major impact-producing factors resulting from the accidental activities associated with the WPA proposed action that may affect loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles include accidental blowouts, oil spills, and spill-response activities. These have the potential to impact small to large numbers of sea turtles in the GOM, depending on the magnitude and frequency of accidents, the ability to respond to accidents, the location and date of accidents, and various meteorological and hydrological factors. Chronic or acute exposure may result in harassment, harm, or mortality of sea turtles occurring in the northern Gulf. Exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick are expected to most often result in sublethal impacts (e.g., decreased health and/or reproductive fitness and increased vulnerability to disease) to sea turtles. Sea turtle hatchling exposure to, fouling by, or consumption of tarballs persisting in the sea following the dispersal of an oil slick would likely be fatal. Sea turtle eggs are likely to be lethally impacted by contact with spilled oil (USDOI, NPS, 2010). The potential effects associated with a low-probability large spill may be more severe than a smaller accidental spill and could potentially contribute to longer-lasting and larger-scale effects. **Appendix B** discuses, in general, the magnitude and duration of effects possible if the low-probability, large-volume spill was to occur in the Gulf of Mexico.

The blowout of the *Ixtoc I* offshore drilling rig in the Bay of Campeche, Mexico, on June 3, 1979, resulted in the release of 500,000 metric tons (140 million gallons) of oil and transport of this oil into the Gulf of Mexico (ERCO, 1982). Three million gallons of oil impacted Texas beaches (ERCO, 1982). According to the ERCO study, "Whether or not hypoxic conditions could, in fact, be responsible for area-wide reductions in [invertebrate] faunal abundance is unclear, however." Of the three sea turtles found dead in the U.S., all had petroleum hydrocarbons in the tissues examined and there was selective elimination of portions of this oil, indicating chronic exposure (Hall et al., 1983). Therefore, the effects of the *Ixtoc* spill on sea turtles in waters off Texas are still unknown.

For water depths >300 m (984 ft), 29-37 blowouts are estimated for the WPA proposed action over the 2007-2046 period (Table 4-5 of the Multisale EIS). The risk of various sizes of oil spills occurring in the WPA is presented in Table 3-5 of the Multisale EIS. The possibility of a spill ≥10,000 bbl in the WPA is estimated to be up to one spill during the 40-year period of the proposed action. The possibility of oil from a surface spill reaching depths of 300 m (984 ft) or greater in any measurable concentration is very small.

The oil from an oil spill can adversely affect sea turtles by causing soft tissue irritation, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil and/or tar, and temporary displacement from preferred habitats. The long-term impacts to sea turtle populations are poorly understood but could include decreased survival and lowered reproductive success. The range of toxicity, the degree of sensitivity to oil hydrocarbons, and the effects of cleanup activities on sea turtles are unknown. Impacts from the dispersants are unknown, but they may have similar irritants to tissues and sensitive membranes as they are known to have had on seabirds and sea turtles (NRC, 2005). The impacts to diamondback terrapins from chemical dispersants could include nonlethal injury (e.g., tissue irritation, inhalation), long-term exposure through bioaccumulation, and potential shifts in distribution from some habitats.

During the oil-spill response related to the DWH event, NMFS and FWS undertook an unprecedented attempt to relocate a number of sea turtle nests and eggs that were located on beaches affected, or that were believed to be at risk of, spilled oil (see the discussion in **Chapter 4.1.1.11.1**). This experimental approach had not been attempted on a large scale for any prior spill. The fate of these relocated hatchlings may never be known, since none of the individuals were tagged and tracked. There are concerns over the potential success of this program, given that these species tend to return to their natal beaches as adults to nest. In addition, sea turtle species require at least a decade before they reach sexual maturity. Even in 10 years, data on nestings would likely be inconclusive as it would be impossible to tell which returning females, if any, are from this relocation experiment.

In the 2007 Biological Opinion Incidental Take Statement, NMFS believes that a small number of listed species would experience adverse effects as the result of exposure to a large oil spill or ingestion of accidentally spilled oil over the lifetime of proposed WPA Lease Sale 218 (USDOC, NMFS, 2007b). However, NMFS is not including incidental take of listed species due to oil exposure in this Incidental Take Statement, as it is an otherwise unlawful activity. Incidental take, as defined at 50 CFR 402.02, refers only to takings that result from an otherwise lawful activity. The Clean Water Act (33 U.S.C. 1251 et seq.), as amended by the Oil Pollution Act of 1990 (33 U.S.C. 2701 et seq.), prohibits discharges of harmful quantities of oil, as defined at 40 CFR 110.3, into waters of the United States. Therefore, even though the Biological Opinion (USDOC, NMFS, 2007b; USDOI, FWS, 2007) considered the effects on listed species by oil spills that may result from proposed WPA Lease Sale 218, those takings that would result from an unlawful activity (i.e., oil spills) are not specified in the Incidental Take Statement and have no protective coverage under Section 7(o)(2) of the ESA. As discussed previously, BOEMRE has requested reinitiation of ESA consultation with both NMFS and FWS. Pending completion of this reinitiated consultation, BOEMRE is working with both agencies to develop an interim coordination policy and the current consultation remains in effect.

Summary and Conclusion

The analysis of the effects from accidental spills (non-catastrophic) on sea turtles remains unchanged from what was concluded in the Multisale EIS and the 2009-2012 Supplemental EIS. Impacts on sea turtles from smaller accidental events are likely to affect individual sea turtles in the spill area, as described above and within the Multisale EIS and the 2009-2012 Supplemental EIS, but they are unlikely to rise to the level of population effects (or significance) given the size and scope of such spills. Further, the potential remains for smaller accidental spills to occur in the proposed action area, regardless of any alternative selected under this Supplemental EIS, given there are 1,394 active leases already in this area with either ongoing or the potential for exploration, drilling, and production activities.

For low-probability catastrophic spills, the Multisale EIS, the 2009-2012 Supplemental EIS, and **Appendix B** of this Supplemental EIS conclude that there is a potential for a low-probability catastrophic event to result in significant, population-level effects on affected sea turtle species. The BOEMRE continues to concur with the conclusions from these analyses.

The BOEMRE concludes that there is incomplete or unavailable information that may lead to reasonably foreseeable significant adverse impacts to sea turtles from accidental events. For example, there is incomplete information on impacts to sea turtle populations from the DWH event. Relevant data on the status of and impacts to sea turtle populations from the DWH may take years to acquire and analyze, and impacts from the DWH may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeframe contemplated in this Supplemental EIS, regardless of the cost or resources needed. In the absence of this information, BOEMRE subject-matter experts have used what scientifically credible information that is available and applied using accepted scientific methodologies. The BOEMRE does not, however, believe this incomplete information is essential to make a reasoned choice among alternatives primarily because activities that could result in an accidental spill in the WPA would be ongoing whether or not the lease sale under the proposed action of this Supplemental EIS occurred. At present, there are 1,394 active leases in the proposed action area that are engaged, or have the potential to be engaged, in drilling and/or production activities that could theoretically result in an accidental spill. Given these existing leases and this ongoing activity, any incomplete information that may lead to reasonably foreseeable significant adverse impacts to sea turtles is not needed to make a reasoned choice among alternatives, including the No Action alternative.

4.1.1.11.4. Cumulative Impacts

A detailed impact analysis of sea turtles for proposed WPA Lease Sale 218 can be found in Chapter 4.5.6 of the Multisale EIS and in Chapter 4.1.7.4 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Background/Introduction

The major impact-producing factors resulting from cumulative OCS energy-related activities associated with the WPA proposed action that may affect loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles and their habitats include marine debris, contaminant spills and spill-response activities, vessel traffic, noise, seismic surveys, and explosive structure removals. Non-OCS energy-related activities that may affect sea turtle populations include vessel traffic and related noise (including from commercial shipping and research vessels), military operations, commercial fishing, and pollution. The cumulative impact of these ongoing OCS energy-related activities on sea turtles is expected to result in a number of chronic and sporadic sublethal effects (i.e., behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) because these activities may stress and/or weaken individuals of a local group or population and may predispose them to infection from natural or anthropogenic sources. There is no new information regarding effects of non-OCS energy-related activities since the prior NEPA analyses that would alter the conclusions contained in the Multisale EIS and 2009-2012 Supplemental EIS. These non-OCS energy program related activities include historic overexploitation (which led to listing of the species), commercial fishery interactions, habitat loss, dredging, pollution, vessel strikes, and pathogens.

As described in **Chapter 4.1.1.11.2**, few deaths are expected from chance collisions with OCS service vessels, ingestion of plastic material, commercial fishing, and pathogens. Disturbance (noise from vessel traffic and drilling operations) and/or exposure to sublethal levels of toxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them more vulnerable to parasites and diseases that normally would not be fatal during their life cycle. The net result of any disturbance depends upon the size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). As discussed above, lease stipulations and regulations are in place to reduce vessel strike mortalities. As discussed in **Appendix B**, a low-probability, large-scale catastrophic event could have population-level effects on sea turtles.

The effects of the proposed action, when viewed in light of the effects associated with other past, present, and reasonably foreseeable future activities, may result in greater impacts to sea turtles than before the DWH event; however, the magnitude of those effects cannot yet be determined. Nonetheless, operators are required to follow all applicable lease stipulations and regulations, as clarified by NTL's, to minimize these potential interactions and impacts. The operator's reaffirmed compliance with NTL 2007-G04 ("Vessel-Strike Avoidance") and NTL 2007-G03 ("Marine Trash and Debris"), as well as the limited scope, timing, and geographic location of the proposed action, would result in negligible effects from the proposed drilling activities on sea turtles. In addition, NTL 2007-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," minimizes the potential of harm from seismic operations to sea turtles and marine mammals; these mitigations include onboard observers, airgun shut-downs for whales in the exclusion zone, ramp-up procedures, and the use of a minimum sound source. Therefore, no significant cumulative impacts to sea turtles would be expected as a result of the proposed exploration activities when added to the impacts of past, present, or reasonably foreseeable oil and gas development in the area, as well as other ongoing activities in the area.

Adverse effects may result from the incremental contribution of proposed WPA Lease Sale 218 combined with non-OCS energy-related activities. The biological significance of any mortality or adverse impact would depend, in part, on the size and reproductive rates of the affected populations, as well as the number, age, and size of animals affected. However, as the analyses above indicate, the potential for impacts is mainly focused on the individual, and population-level impacts are not anticipated based on the best available information.

Incremental injury effects from the proposed action on sea turtles are expected to be negligible for drilling and vessel noise and minor for vessel collisions, but it will not rise to the level of significance because of the limited scope, duration, and geographic area of the proposed drilling and vessel activities and the relevant regulatory requirements.

The effects of the proposed action, when viewed in light of the effects associated with other relevant activities, may affect sea turtles occurring in the Gulf of Mexico. With the enforcement of regulatory requirements for drilling and vessel operations and the scope of the proposed action, incremental effects from the proposed drilling activities on sea turtles will be negligible (drilling and vessel noise) to minor (vessel strikes). The best available scientific information indicates that sea turtles do not rely on acoustics; therefore, vessel noise and related activities would have limited effect. Consequently, no significant cumulative impacts would be expected from the WPA proposed activities or as the result of past, present, or reasonably foreseeable oil and gas leasing, exploration, development, and production in the Gulf of Mexico. Even taking into account additional effects resulting from non-OCS energy-related activities, the potential for impacts from the proposed action is mainly focused on the individual. Population-level impacts are not anticipated based on the best available information.

Summary and Conclusion

The BOEMRE has considered this assessment and reexamined the cumulative analysis for sea turtles presented in the Multisale EIS, in the 2009-2012 Supplemental EIS, and the cited new information.

Based on this evaluation, conclusions in these analyses on effects to sea turtles remain unchanged in regards to Routine Activities (no potential for significant adverse effects) and Accidental Spills (potential for significant adverse effects).

Unavailable information on the effects to sea turtles from the DWH event (and thus changes to the sea turtle baseline in the Affected Environment) makes an understanding of the cumulative effects less clear. Here, BOEMRE concludes that the unavailable information from these events may be relevant to foreseeable significant adverse impacts to sea turtles. Relevant data on the status of sea turtle populations after the DWH and increased sea turtle GOM strandings may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeframe contemplated in this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEMRE subject-matter experts have used available scientifically credible evidence in this analysis and based upon accepted methods and approaches.

Nevertheless, a complete understanding of the missing information is not essential to a reasoned choice among the alternatives for this Supplemental EIS (including the No Action and Action Alternatives) for two main reasons:

(1) There are 1,394 active leases in the WPA with ongoing (or the potential for) exploration, drilling, and production activities. In addition, non-OCS energy-related activities will continue to occur in the WPA irrespective of this proposed lease sale (i.e., fishing, military activities, scientific research, and shoreline development). The potential for effects from changes to the Affected Environment (post -DWH), Routine Activities, Accidental Spills (including low-probability catastrophic spills), and Cumulative Effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on sea turtles from either smaller accidental events or low-probability catastrophic events will remain the same.

(2) All wide-ranging populations of sea turtles that may occur in the WPA and within areas affected by the spill are unlikely to have experienced population-level effects from the DWH event given their wide-ranging distribution and behaviors.

Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that activities from the pre-existing OCS program are significantly impacting sea turtle populations. Therefore, in light of the above analysis on the proposed action and its impacts, the incremental effect of the proposed action on sea turtle populations is not expected to be significant when compared with non-OCS energy-related activities.

In any event, the incremental contribution of the proposed action would not be likely to result in a significant incremental impact on sea turtles within the WPA; in comparison, non-OCS-related activities, such as overexploitation, commercial fishing, and pollution, have historically proved to be of greater threat to the sea turtle species.

4.1.1.12. Coastal and Marine Birds

The BOEMRE has reexamined the analysis for coastal and marine birds presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusion for coastal and marine birds presented in the Multisale EIS and the 2009-2012 Supplemental EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in Chapters 4.2.1.1.7, 4.2.2.1.8, 4.4.8, and 4.5.8 of the Multisale EIS. A summary of those analyses and their reexamination due to new information is presented in the following sections. A brief summary of potential impacts follows. The majority of impacts resulting from routine activities associated with the WPA proposed action on endangered/threatened and nonendangered/nonthreatened coastal and marine birds are expected to be sublethal. In the case of a catastrophic spill, both lethal and sublethal impacts would be expected to be substantial, with sublethal impacts likely being more frequent.

These impacts include behavioral effects, exposure to or intake of OCS-related contaminants or discarded debris, temporary disturbances, and displacement of localized groups from impacted habitats. Impacts from potential oil spills associated with the proposed action and oil-spill cleanup on birds are expected to be negligible; however, small amounts of oil can affect birds and there are possible delayed impacts on their food supply. The effect of cumulative activities on coastal and marine birds is expected to result in a discernible decline in the numbers of birds that form localized flocks or populations, with associated changes in species composition and distribution. The incremental contribution of the WPA proposed action to cumulative impacts is expected to be negligible because it would not seriously alter species composition and cause major reductions in the overall carrying capacity of disturbed areas.

4.1.1.12.1. Description of the Affected Environment

A detailed description of coastal and marine birds can be found in Chapter 3.2.6 of the Multisale EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared. A search of Internet bibliographic databases, as well as personal interviews with authors of references used in the Multisale EIS, was conducted to determine the availability of recent information since publication of the Multisale EIS. No new information on the description of bird resources in the WPA was found from these information sources and/or the available resources relating to the DWH event that would alter the conclusions of the Multisale or 2009-2012 Supplemental EIS.

Nonendangered and Nonthreatened Species

A detailed description of bird species, colonial breeding, and foraging habits of nonendangered and nonthreatened coastal and marine birds can be found in Chapter 3.2.6.1 of the Multisale EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, which incorporates new information found since the publication of these documents.

Most bird species are protected by the Migratory Bird Treaty Act; only birds that are not native or a very few that are designated as nonmigratory are not protected by the Treaty. The Gulf of Mexico is populated by both resident and migratory species of coastal and marine birds (Parnell et al., 1988; Visser and Peterson, 1994; Mikuska et al., 1998; Miller and Fontenot, 2001; Rappole, 2006). They are herein separated into seven major groups: diving birds, seabirds, shorebirds, passerines, marsh and tall wading birds, waterfowl, and raptors. Many species are mostly pelagic and, therefore, are rarely sighted near shore. The remaining species are found within coastal and inshore habitats and are more susceptible to potential deleterious effects resulting from OCS-related activities (Clapp et al., 1982). Previous surveys indicate that Louisiana and Texas are among the primary states in the southern and southeastern U.S. for both nesting colonies and total number of breeding coastal and marine birds (Martin and Lester, 1991; Martin, 1991).

Diving Birds

Diving seabirds are discussed separately in the seabirds section and diving ducks are discussed in the waterfowl section. Diving birds are a diverse group. There are three main groups of diving birds: cormorants and anhingas (Pelecaniformes), loons (Gaviiformes), and grebes (Podicipediformes). Many seabirds, such as the brown pelican, dive; however, they are traditionally called seabirds, as they are in this analysis. The only representative diving bird known to breed in the Gulf is the cormorant. The common diving birds in the northern GOM are listed with their seasons of occurrence, feeding behavior, and diet in Table 3-6 of the Multisale EIS.

Diving birds typically live in bays and coastal habitats. They do not generally migrate laterally from east to west along the Gulf Coast. Therefore, it is unlikely that any diving birds present in the CPA during the DWH event, and impacted by the spill, would have migrated into the WPA. They are mostly winter residents that migrate north for the summer to breed or they are permanent residents (Table 3-6 of the Multisale EIS).

Seabirds

Three taxonomic orders contain seabirds (defined as species that spend a large portion of their lives on or over seawater) in the offshore waters of the northern Gulf of Mexico: (1) Procellariiformes (albatrosses, petrels, shearwaters, and storm-petrels); (2) Pelecaniformes (frigatebirds, tropicbirds, gannets, brown pelican, and boobies); and (3) Charadriiformes (phalaropes, skuas and jaegers, gulls, and terns) (Clapp et al., 1982; Harrison, 1983; Warham, 1990; Olsen and Larsson, 1995 and 1997; Peake et al., 1995; Harrison, 1996; National Geographic Society, 1999). The brown pelican was removed from the threatened and endangered list on November 17, 2009 (*Federal Register*, 2009d). The species is still protected under the Migratory Bird Treaty Act and also has special conservation status in all coastal states except Alabama. Colonies of laughing gulls, eight species of terns, and black skimmers nest in the Gulf (Martin and Lester, 1991; Pashley, 1991). A census of south Louisiana seabird nesting colonies was completed in 2001 (Michot et al., 2003). Collectively, many seabirds live far from land most of the year, roosting on the water surface, except at breeding time when they return to nesting areas along coastlines (Terres, 1991). Seabirds typically aggregate in social nesting groups called colonies; the degree of colony formation varies among species. Much of the deep ocean is relatively devoid of avifauna because of low concentrations of nutrients for phytoplankton. However, certain oceanic conditions including upwelling, convergences, divergences, specific sea-surface temperatures, thermal fronts, salinities, areas of high planktonic productivity, or current activity create veritable oases for foraging seabirds. Seabirds obtain their food through a variety of behaviors including kleptoparasitism, scavenging, dipping, plunge diving, and surface feeding. Nesting terns include Caspian (*Sterna caspia)*, royal (*S. maxima*), sandwich (*S. sandvicensis*), common (*S. hirundo*), Forster's (*S. forsteri*), coastal least (*S. antillarum*), gull-billed (*Sterna nilotica*), and sooty (*S. fuscata*). All of the terns nesting in the GOM, as well as the Arctic tern (*S. paradisaea*), bridled tern (*S. anaethetus*), black tern (*Chlidonias niger*), brown noddy (*Anous stolidus*), and black noddy (*Anous minutus*), are found in blue water in the northern GOM (Cardiff, official communication, 2006). Most of these species forage exclusively on small fish and feed by plunge diving, often from a hovering position. Terns, and gannets and boobies (*Sula* spp.) as well, are streamlined for plunge diving and the underwater pursuit of fish. All seabirds are colonial nesters and all evolved from colonial land birds. Most land birds are not colonial nesters (Lack, 1968). A discussion of the colonial breeding of seabirds is relevant to their increased potential vulnerability to anthropogenic noise, as presented in Chapter 3.2.6.1 of the Multisale EIS. The collective feeding characteristic of many colonial nesters and other birds is also discussed. The small body-size of terns is a factor in their vulnerability to OCS-related activities and their general ecology.

Impacts of widespread dispersed oil from the DWH event may have had serious impacts on pelagic birds feeding in oiled waters and/or on oiled prey. Oil slicks from the spill covered substantial amounts of offshore pelagic bird habitat in the CPA, although the westernmost extent of the sheen and plume remained east of the WPA boundary. Seasonal distribution of offshore seabirds is little studied, and seasonal offshore movements are almost unknown. Seabirds oiled far offshore would be unlikely to persist long enough to wash ashore and be recorded as impacted by oil. While oiled seabirds were collected in the CPA and EPA, no oiled seabirds were collected in the WPA. The baseline for pelagic birds in the affected environment of the proposed action may have been negatively affected by birds migrating into the WPA after the DWH event. This information is being developed through the NRDA process, which may take many years, and what information NRDA has compiled to date is not publicly available at this time. As there is a process ongoing that may take years, given the realities of the DWH event, cost is not a relevant factor in BOEMRE's ability to obtain this information—it cannot be obtained at this time under any circumstances. Although this information would be relevant to reasonably foreseeable significant impacts, BOEMRE does not believe it is essential to a reasoned choice among alternatives because effects of the DWH event, as evidenced by impacted birds that may have migrated into the WPA, would not be expected to rise to population level impacts in the WPA. The BOEMRE has applied what scientifically credible information is available using accepted methodologies as described above.

Shorebirds

Shorebirds are members of the order Charadriiformes and are generally restricted to coastline and inland water margins (e.g., beaches, mudflats, etc.). The Gulf of Mexico shorebirds comprise five taxonomic families: Jacanidae (jacanas), Haematopodidae (oystercatchers), Recurvirostridae (stilts and avocets), Charadriidae (plovers), and Scolopacidae (sandpipers, snipe, and allies) (Hayman et al., 1986). Most of the shorebirds are solitary nesters. Shorebird habitat and species in the WPA are similar to that of the CPA, comprising mostly coastal wetlands and beaches. Along the central Gulf Coast (Louisiana, Mississippi, and Alabama), 44 species of shorebirds have been recorded. However, only 6 species are known breeders in the area; the remaining 38 species are considered winter residents and/migrants (Pashley, 1991).

Many of the overwintering shorebird species remain within specific areas throughout the season and exhibit among-year wintering site fidelity, at least when not disturbed by humans. These species may be especially susceptible to localized impacts, resulting in habitat loss or degradation unless they move to more favorable habitats when they are disturbed by humans.

An important characteristic of almost all shorebird species is their strongly developed migratory behavior, with some shorebirds migrating from nesting places in the high Arctic tundra to the southern part of South America (Morrison 1984; Terres, 1991; Morrison et al., 2000, 2001, and 2006). Their migratory abilities expose them to a constraint perhaps more than other, less capable migrants. A recent study shows that all Arctic-breeding shorebirds (worldwide) tend to avoid migration routes that require individuals to negotiate barriers, including the Arctic Ocean itself, where landing and feeding cannot take place (Henningsson and Alerstam, 2005).

Both spring and fall migrations take place in a series of stops among various staging areas where birds spend time feeding heavily to store up fat for the sustained flight to the next staging area (Skagen and Knopf, 1993; De Leon and Smith, 1999; Farmer and Durbian, 2006; Krapu et al., 2006; Skagen et al., 2008); many coastal habitats along the GOM are critical for such purposes. Shorebird species of conservation concern in coastal Louisiana are dunlin, short-billed dowitcher, marbled godwit, American oystercatcher, and the piping, Wilson's, and snowy plovers. Birds that migrated through or wintered along the northern Gulf of Mexico in the fall of 2010 and the spring of 2011 east of Texas likely have experienced impacts from the DWH event, but it is not yet clear if any bird taxa will be altered long term by the spill and cleanup operations. Some shorebirds stopping over on the Gulf Coast in the CPA before trans-Gulf migration south in the fall would likely be impacted by oil from the DWH event. They would be unlikely to follow the coast into the WPA to cross the Gulf because the heaviest trans-Gulf migration of birds in general is from the stretch of the northern Gulf Coast running eastward from Alabama (Russell, 2005). Shorebirds stopping over on the Gulf Coast after trans-Gulf migration in fall would likely follow a clockwise path mostly over the western Gulf, which is taken by the heaviest migration of birds in general (Russell, 2005). In fall, those making landfall on the coast of Texas likely would continue inland to minimize migration time for prompt arrival on breeding grounds (optimizing reproductive success) and would not be affected by oil from the DWH event (Russell, 2005). Any delay in migration would disturb the synchronization of breeding with the cycle of food resource availability on the breeding grounds. Many transients, including most calidrid sandpipers, nest in Arctic Canada and Alaska. They feed on insects, a variety of marine and freshwater invertebrates, fish, and small amounts of plant life. Coastal sandpipers may not find adequate food in nontidal habitats with a static shoreline because of insufficient size of invertebrate forage populations.

Shorebirds, including sandpipers, have adapted to utilize highly ephemeral habitats, including advancing and/or receding with the changing shoreline of wetlands transiently exposed over a substantially greater area (relative to narrow, linear, nontidal wetlands) to lunar, solar, or wind-driven tides. Sandpiper legs are moderately long for wading and foraging just seaward of the shoreline, and their bills and necks are moderately long for pecking on small invertebrates on the sediment surface or probing beneath the sediment. Plovers are adapted to follow solar, lunar, or wind tides in and out, foraging just landward of the water's edge. Not being waders, plovers often have relatively shorter bills, necks, and legs than sandpipers. Rising tides and low wave action would cause or facilitate accumulation of oil in intertidal vegetation and on soft-bottom flats. Shorebirds feed on flats, and in ponds, pools, shorelines, and rivulets next to wetland vegetation. Substantial wave action and falling tides could offer some recurrent seaward transport of oil; such processes could ameliorate accumulation of intertidal oil.

Passerine Birds

Passerine birds mostly migrate across the Gulf of Mexico each spring and fall and are protected along with most bird species under the Migratory Bird Treaty Act. Passerines must cross the Gulf non-stop and are at risk for exhaustion and starvation. A study of platforms as possible resting sites for birds crossing the Gulf was completed (Russell, 2005) and is summarized in Chapter 3.2.6.1 of the Multisale EIS. Migrants sometimes arrived at certain platforms shortly after nightfall and proceeded to circle those platforms for variable periods ranging from minutes to hours. These nocturnal circulations clearly occurred because nocturnal migrants were attracted to platform light and tended to occur on overcast nights. Such circulation prevails when birds get inside the cone of light surrounding the platform and are reluctant to leave, seemingly becoming trapped by the surrounding "wall of darkness" and loss of visual cues to the horizon. Circulations put birds at risk for collision with the platform or with each other, as well as result in energetic deficits exacerbating migration-induced mortality via starvation (Russell, 2005). Mitigation for this mortality has not been developed. Platforms may serve as stopover sites for migrating birds tired from nocturnal circulation.

Passerine migrants stopping over on the Gulf Coast in the CPA before trans-Gulf migration south in the fall or after trans-Gulf migration north in the spring are not aquatic or associated with beach or dune habitat, and they would not likely be impacted by oil from the DWH event, with the possible exception of the seaside sparrow (USDOI, FWS, 2011). Of about 21 species of songbirds collected alive or dead after the DWH event, only 4 (including the seaside sparrow) were found more than twice; a total of 9 seaside sparrows were collected (USDOI, FWS 2011). That species would be unlikely to follow the coast from the CPA into the WPA before crossing the Gulf because the heaviest trans-Gulf migration of birds in general is from the stretch of the northern Gulf Coast running eastward from Alabama (Russell, 2005). Seaside sparrows stopping over on the Gulf Coast after trans-Gulf migration in fall would likely follow a clockwise path mostly over the western Gulf, which is taken by the heaviest migration of birds in general (Russell, 2005).

Marsh and Tall Wading Birds

Collectively, the following families of tall wading birds have representatives in the northern Gulf: Ardeidae (herons, bitterns and egrets), Ciconiidae (wood storks), Threskiornithidae (ibises and spoonbills), and Gruidae (whooping crane and sandhill crane). The common wading birds in the northern GOM are listed with their main features in Table 3-7 of the Multisale EIS. A census of south Louisiana wading bird nesting colonies was completed in 2001 (Michot et al., 2003). Wading birds are those birds that have adapted to living in shallow water. They have long legs that allow them to forage by wading into shallow water, while their long bills, usually accompanied by long necks, are used to probe under water or to make long swift strokes to seize fish, frogs, aquatic insects, crustaceans, and other prey (Terres, 1991). In coastal Louisiana, species of special concern include the ardeids reddish egret, yellow-crowned night heron, and American bittern; the ciconiid wood stork (in freshwater marshes), which is federally listed as endangered in Alabama and Florida; and the gruid whooping crane, which is federally listed as endangered in Texas and which has a planned, experimental-introduced population in Louisiana. A total of 10 whooping cranes were reintroduced to Louisiana in the White Lake Conservation Area during the winter of 2011 as a nonessential experimental population.

Seventeen species of wading birds in the Order Ciconiiformes are currently known to nest in the northern Gulf coastal region, and all except the wood stork nest in the northern Gulf coastal region (Martin, 1991). Within the central Gulf Coast region, Louisiana supports the majority of nesting wading birds (Miller and Fontenot, 2001, Rappole, 2006). Nests tend to be concentrated in freshwater riparian bottomland hardwood forest wetlands. Great egrets are the most widespread nesting species in the central Gulf region (Martin, 1991), while little blue herons, snowy egrets, and tricolored herons constitute the greatest number of coastal nesting pairs in the western Gulf Coast (Texas Parks and Wildlife Department, 1990). The term "marsh bird" is a general term for a bird that lives in or around marshes and swamps. Members of the Rallidae family (rails, including moorhens, and gallinules) are labeled marsh birds and not wading birds. They are elusive and rarely seen within the low vegetation of fresh and saline marshes, swamps, and rice fields, where they walk on long toes (Bent, 1926; Ripley and Beehler, 1985, Eddleman et al., 1988; National Geographic Society, 1999). They run through the marsh when disturbed, rather than flying.

Marsh and tall wading birds spend the majority of their lifecycles in wetlands and marshes. These birds do not typically migrate any distance and do not laterally migrate from east to west. All but least bittern, white faced ibis, and roseate spoonbill are permanent residents. As such, marsh and tall wading birds that were in the CPA during the DWH event, and that may have been impacted by the DWH event, are unlikely to have migrated into the WPA.

Waterfowl

Waterfowl belong to the taxonomic order Anseriformes and include swans, geese, and ducks. A total of 33 species are regularly reported along the north-central and western Gulf Coast, consisting of 1 swan, 5 geese (i.e., greater white-fronted [*Anser albifrons*], Ross's [*Chen rossii*], snow [*C. caerulescens*], Canada [*Branta canadensis*], and Brant [*B. brenicla*]), 8 surface-feeding (dabbling) ducks (genus *Anas*; i.e., mallard, mottled, American wigeon, northern pintail, northern shoveler, blue-winged teal, American green-winged teal, and gadwall); 5 diving pochards (genus *Aythya*; canvasback, redhead, lesser scaup, greater scaup, and ring-necked duck), and 14 others (including the wood duck [*Aix sponsa*], fulvous whistling ducks [*Dendrocygna bicolor*], black-bellied whistling duck [*D. autumnalis*], bufflehead [*Bucephala albeola*], common goldeneye [*B. clangula*], hooded merganser [*Lophodytes cucculatus*], red-breasted merganser [*Mergus serrator*], and ruddy duck [*Oxyura jamaicensis*]) (Clapp et al., 1982; National Geographic Society, 1999; Madge and Burn, 1988; Alsop, 2001). The common waterfowl in the northern GOM are listed with their main features in Table 3-8 of the Multisale EIS. Many species usually migrate from wintering grounds along the Gulf Coast to summer breeding grounds in the prairies, parklands, and tundra in the north. Waterfowl migration pathways have traditionally been divided into four parallel north-south paths, or "flyways," across the North American continent (Bellrose 1980). The Gulf Coast serves as the southern terminus of both the Central (Texas) and Mississippi (Louisiana, Mississippi, and Alabama) flyways, and winters an estimated 8-10 million ducks, 500,000 geese, and 1-1.5 million American coots (Bellrose, 1980; Chabreck et al., 1989; Hobaugh et al., 1989; Stuzenbacker and Weller, 1989). Flyways are somewhat abstract generalizations of migratory behavior. Some birds at some latitudes migrate laterally (along an east-west axis) within or between flyways. However, trans-Gulf migrant waterfowl making landfall in the CPA and being exposed to oil from the DWH event would not likely migrate laterally into the WPA because it would be a much longer route and therefore would represent a detrimental delay to the start of the breeding cycle. Waterfowl are highly social and possess a diverse array of feeding adaptations related to their habitat (Johnsgard, 1975; Poysa, 1983; Nudds, 1983 and 1992). Waterfowl young are precocial, leaving their nests relatively soon after they hatch and, thus, they are capable of swimming and feeding. Most waterfowl species in the northern Gulf of Mexico are winter residents and migrate far to the north to breed (Sibley, 2000; Alsop, 2001). Herbivorous geese must eat relatively more food than most omnivorous or carnivorous waterbirds like ducks. Geese digest little of the vegetation they gorge on because much of it is indigestible. Feces can provide immediate cycling of nitrogen in nitrogen-limited vegetation.

Raptors

The American peregrine falcon was removed from the endangered species list on August 25, 1999 (*Federal Register*, 1999). The species is still protected under the Migratory Bird Treaty Act. The FWS will continue to monitor the falcon's status 5 times at 3-year intervals beginning in 2003 and ending in 2015 to ensure that recovery is established. The bald eagle was delisted on August 8, 2007. It is still afforded some protection under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The Northern harrier is listed as a species of concern in Louisiana. It forages in salt, brackish, intermediate, and fresh marsh and coastal dune-grassland shrub thicket habitat.

Raptors are not likely to migrate laterally from east to west. As such, raptors that were in the CPA during the DWH event and that were impacted by the spill are unlikely to have migrated into the WPA.

Endangered and Threatened Species

A detailed description of endangered and threatened coastal and marine bird species can be found in Chapter 3.2.6.2 of the Multisale EIS. The following is a summary of the information presented in the

Multisale EIS and the 2009-2012 Supplemental EIS, which incorporates new information found since the publication of these documents.

The Multisale EIS included the bald eagle in the discussion of the endangered and threatened species. However, on June 28, 2007, FWS announced the removal of the bald eagle from the list of endangered and threatened species (*Federal Register*, 2007). The FWS will work with State wildlife agencies to monitor bald eagles for at least 5 years. The FWS can propose to relist the species if it appears that bald eagles again need the protection of the Endangered Species Act. The bald eagle will continue to be protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Both Federal laws prohibit "taking" (i.e., killing, selling, or otherwise harming eagles, their nests, or eggs). In this Supplemental EIS, the bald eagle is addressed under the section on raptors above.

The Multisale EIS included the brown pelican in the discussion of the endangered and threatened species. However, the brown pelican was removed from the list of endangered and threatened wildlife on November 17, 2009 (*Federal Register*, 2009). In this Supplemental EIS, the brown pelican is addressed under the section on seabirds above.

Coastal and marine bird species that inhabit or frequent the north-central and western Gulf of Mexico coastal areas and that are recognized by FWS as either endangered or threatened include the piping plover and whooping crane.

Piping Plover

The piping plover (*Charadrius melodus*) is a migratory shorebird that is endemic to North America. The piping plover breeds along shorelines in the northern Great Plains, the Great Lakes, and along the Atlantic Coast (Newfoundland to North Carolina). It winters on the Atlantic and Gulf Coasts from North Carolina to Mexico and in the Bahamas West Indies. The final rule on critical habitat for the piping plover was published July 10, 2001; there are 20 units of critical habitat in western Florida south to Tampa Bay, 3 areas in Alabama, 15 in Mississippi, 7 in Louisiana, and 37 in Texas (*Federal Register*, 2001). Critical wintering habitat includes the land between mean low water and any densely vegetated habitat that is not used by the piping plover. The piping plover is listed as endangered on its Great Lakes breeding grounds. It is listed as threatened in the Gulf of Mexico and the rest of its wintering and breeding range. The habitats used by wintering birds include beaches, mud flats, sand flats, algal flats, and washover passes (areas where breaks in the sand dunes result in an inlet). Wintering plovers are dependent on a mosaic of habitat patches and move among these patches depending on local weather and tidal conditions. It has been hypothesized that specific wintering habitat, which includes coastal sand flats and mud flats in close proximity to large inlets or passes, may attract the largest concentrations of piping plovers because of a preferred prey base and/the substrate color provides protection from aerial predators due to cryptic blending camouflage color (Nicholls and Baldassarre, 1990). The migration of the piping plover is poorly understood. They begin arriving on the wintering grounds in July and continue arriving through September. In late February, piping plovers begin leaving the wintering grounds to migrate back to their breeding sites. Northward migration peaks in late March, and by late May most birds have left the wintering grounds. The FWS indicates that the presence of vegetation on the breeding grounds in the Great Plains, the Great Lakes, and along the Atlantic Coast (Newfoundland to North Carolina) imposes an extreme threat of predators on breeding adults (USDOI, FWS, 2003). On the northern breeding grounds, river alteration and reservoir creation cause high water flow where birds once relied on exposed sand bars to breed. However, diversion of peak flows in northern nesting habitat is also harmful. The result is the encroachment of vegetation that is usually kept under control by scour during high river flows. This species remains in a precarious state given its low population numbers, sparse distribution, and continued threats to habitat throughout its range. Unlike the breeding grounds in the Great Plains, the Great Lakes and along the Atlantic Coast, there are far fewer stresses to the piping plover at its wintering grounds, including those in the WPA, as there are far more suitable habitats in the WPA. About 2,299 birds were located on the U.S. wintering grounds during the 2001 census (Haig and Ferland, 2002). During the winter 2006 census, 321 birds were counted on the Gulf Coast of Florida; 29 in Alabama; 78 in Mississippi; 226 in Louisiana; and 2,090 in Texas (Elliot-Smith et al., 2009). The final rule on the critical habitat for piping plover was published July 10, 2001; there are 20 critical habitat units in western Florida south to Tampa Bay, 3 areas in Alabama, 15 areas in Mississippi, 7 areas in Louisiana, and 37 areas in Texas (*Federal Register*, 2001). The highest numbers of wintering plovers occurred along the Texas coast (43.6%), with Louisiana ranked second (21.4%). Piping plovers were commonly found on mud flats (36.3%), sandy beaches (33.2%), and sand/salt flats (23.1%) (Haig and Ferland, 2002).

Although there is no specific information on impacts on the piping plover since the DWH event, those piping plover that winter in the WPA would not be expected to have been impacted by the spill. First, these birds use the GOM as wintering habitat; therefore, they are not believed to have been in residence during the spill event. In addition, these birds do not cross the Gulf of Mexico and their migration patterns are from north to south, not laterally from the CPA to the WPA. As such, the piping plover found in the WPA are unlikely to have been impacted by the DWH event.

Whooping Crane

The whooping crane (*Grus americana*) is an omnivorous, wading bird. Whooping cranes currently exist in three wild populations and at five captive locations (USDOI, FWS, 1994). All of the populations are listed as endangered. A catastrophic event such as a hurricane could destroy the world's only naturally occurring flock when it is in Texas at the Aransas National Wildlife Refuge (USDOI, FWS, 2007). These whooping cranes originate from only six to eight birds in the 1940's, so their tiny gene pool with lack of genetic variation (variation needed to adapt to any variation in the environment) could harm reproduction in the future (USDOI, FWS, 2007). The Aransas National Wildlife Refuge relies on freshwater from rivers, and Texas water laws do not guarantee supplies will be available in the future (USDOI, FWS, 2007). The only self-sustaining wild population nests in the Northwest Territories and adjacent areas of Alberta, Canada, primarily within the boundaries of Wood Buffalo National Park. These birds winter in coastal marshes and estuarine habitats along the Gulf Coast in the Aransas National Wildlife Refuge in Texas, and they represent the majority of the world's population of free-ranging whooping cranes. Another wild flock was created with the transfer of wild whooping crane eggs from nests in the Wood Buffalo National Park to be reared by wild sandhill cranes in an effort to establish a migratory Rocky Mountains Population (USDOI, FWS, 1994). This population summers in Idaho, western Wyoming, and southwestern Montana, and it winters in the middle Rio Grande Valley, New Mexico. The third wild population is the first step in an effort to establish a nonmigratory population in Florida (USDOI, FWS, 1994). The 2007 wild populations were estimated to total 355; the captive population contained 148 birds (Stehn, official communication, 2007). The 2010 wild populations were estimated to total 401; the 2010 captive populations were estimated to total 166 (Stehn, official communication, 2010). A total of 10 whooping cranes were reintroduced to Louisiana in the White Lake Conservation Area during the winter of 2011 as a nonessential experimental population.

Whooping cranes, as noted above, use the Aransas National Wildlife Refuge in Texas as wintering habitat. As such, they would not have been expected to be in residence during the DWH event in the CPA. In addition, the Macondo well was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). The Aransas National Wildlife Refuge is also protected by a barrier island. As such, it does not appear that the whooping crane's habitat in the WPA was affected by the DWH event. Finally, whooping cranes migrate north to south (to their breeding habitat in the Great Plains and Canada) and therefore would not be expected to have migrated laterally from the CPA into the WPA. As such, it does not appear that whooping cranes in the WPA were impacted by the DWH event.

Effects of Hurricanes Katrina and Rita on Baseline Conditions

A detailed summary of impacts of the hurricanes on birds is provided in Chapter 3.2.6 of the Multisale EIS. Hurricanes may exacerbate impacts of OCS-related and cumulative impacts on coastal and marine birds. Hurricanes Katrina and Rita have impacted avian habitats throughout the Gulf. Large areas of coastal wetlands have been converted to open-water habitat, potentially affecting avian species that used the wetlands for foraging, nesting, and as stopover points during migration (Gabe et al., 2005). Impacts to these habitats have the potential to result in population-level impacts, affecting both abundance and distribution of some species. For example, the coastal habitats that were significantly impacted in southeastern Louisiana and the Galveston Bay area of Texas support nesting by up to 15 percent of the world's brown pelicans and 30 percent of the world's sandwich terns (Hunt, official communication, 2006). Impacts to these habitats could reduce future nesting success and affect overall population levels of these species. Impacts to bottomland forest habitat along the Louisiana and Mississippi coasts represent further loss of avian habitat, affecting many different species; up to 70 percent of the cavity trees used by the endangered red-cockaded woodpecker at Big Branch Marsh National Wildlife Refuge in St. Tammany Parish, Louisiana, were destroyed (Hunt, official communication, 2006). The long-term effects of avian habitat loss because of these hurricanes is not known, and agencies including FWS and USGS are implementing numerous studies and monitoring programs to determine the extent and magnitude of impacts to affected avian populations.

After Hurricane Rita, the Chenier Plain in western Louisiana was sampled for plant and animal food for neotropical migrant birds. Saltwater intrusion killed almost all crawfish being raised in ponds, and it also killed freshwater vegetation there; reptiles, especially amphibians, were also killed by flooding saltwater moving inland. We can expect a possible impact on birds whose populations are controlled by the availability of food. Experimental reasoning tells us from gut contents' analysis experiments and bird distribution studies that birds use the food resources destroyed by the hurricanes. However, no studies on the impacts of hurricanes on bird populations have been done. Hurricanes are regularly experienced by birds in the Gulf of Mexico and some bird populations may have initially declined. Some bird populations may have had a reduced baseline abundance from hurricane-induced mortality. Such mortality may have been compensatory. Recovery may then have begun immediately, due to reduced crowding, and may have been complete.

Effect of the *Deepwater Horizon* Event on Baseline Conditions

The use of waterbird feeding areas at the sea surface and intertidal wetland zone, where spilled oil tends to accumulate, makes them vulnerable to exposure to oil from the DWH event. However, the WPA boundary is located over 300 mi (483 km) from the Macondo well, and the westernmost extent of the plume remained east of the WPA. Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). Impacts or oiling in the WPA have not been reported (**Chapters 4.1.1.2.1.1. and 4.1.1.2.2.1**). Information specific to birds and potential impacts in the WPA is incomplete or unavailable at this time, although as noted above, many species are unlikely to have been impacted. This information is being developed through the NRDA process, which may take many years, and what information NRDA has compiled to date is not publicly available at this time. As there is a process ongoing that may take years, given the realities of the DWH event, cost is not a relevant factor in BOEMRE's ability to obtain this information—it cannot be obtained at this time under any circumstances. The BOEMRE has applied what additional scientifically credible information is available using accepted methodologies as described above. Although this information may be relevant to reasonably foreseeable significant impacts on birds, BOEMRE does not believe it is essential to a reasoned choice among alternatives because effects of the DWH event, as evidenced by impacted birds that may have migrated into the WPA, would not be expected to rise to population-level impacts in the WPA. As described above, many species either do not laterally migrate from the CPA to the WPA, were not in residence during the DWH event, and/or their habitat was not affected.

The DWH event will ultimately allow a better understanding of any realized effects from such a low-probability catastrophic spill. But for the WPA, BOEMRE concludes that the unavailable information from the event may be relevant to foreseeable significant adverse impacts to birds. Relevant data on the status of bird populations after the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. In light of the incomplete or unavailable information, BOEMRE subject-matter experts have used available scientifically credible evidence in this analysis based upon accepted methods and approaches.

4.1.1.12.2. Impacts of Routine Events

Background/Introduction

A detailed impact analysis of the coastal and marine birds for the WPA proposed action can be found in Chapter 4.2.1.1.7 of the Multisale EIS. Any new information since publication of the Multisale EIS is presented in Chapter 4.1.9.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the routine events incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The possible effects of routine activities on coastal and marine birds of the Gulf of Mexico and their habitat in contiguous waters and wetlands are discussed below. Federally listed endangered or threatened bird species are included in this discussion with nonlisted species because the potential impacts are the same or very similar. However, impacts on individuals are more likely to lead to population impacts, including local extinction for the small populations of listed species. Major, potential impact-producing factors for marine birds in the offshore environment include OCS-related helicopter and service-vessel traffic and associated noise, air emissions, degradation of water quality, habitat degradation, pipeline landfalls and other onshore OCS-related construction, discarded trash and debris from service-vessels and OCS structures, and structure presence and associated light and presence. Any effects on birds may be especially important for intensively managed threatened and endangered populations. For example, endangered and threatened species may be harmed by any impact on viable reproductive population size or destruction of or disturbance around key habitats. Chronic sublethal stress is often undetectable in birds. As a result of stress, individuals may weaken, facilitating infection and disease; migratory species may then not have the energetic reserves necessary to complete their migration. However, whooping crane and piping plover, the two listed species in the WPA, have not demonstrated a clear inability to complete migration; as such, at the present time these species are not showing visible signs of stress. The effects of disturbance by air or vessel traffic to birds are highly variable. Behavior patterns may be temporarily influenced (e.g., change from foraging behavior to alert behavior) or birds may be temporarily or permanently displaced. Reproductive behaviors, including pair formation and courtship displays, may be interrupted; breeding birds may become habituated to noise and the presence of humans (Nisbet, 2000). Aircraft may be forced to fly below legal (Federal Aviation Administration or FWS) minimum altitudes in inclement weather, possibly increasing disturbance effects on birds.

Chapter 4.2.1.1.7 of the Multisale EIS provides an in-depth discussion of air pollution pathways and impacts on birds. Air pollution may cause physiological impairment and further lead to diseases. Impacts may include direct mortality, debilitating injury, disease, physiological stress, anemia, hypocalcemic condition, bioaccumulation of air pollutants with associated decrease in resistance to debilitating factors, and population declines and changes in distribution. Levels of sulfur oxide (mainly sulfur dioxide, SO2) emissions from hydrocarbon combustion from OCS-related activities are of concern in relation to birds. Research specific to birds has elucidated both acute and chronic effects from SO2 inhalation (Fedde and Kuhlmann, 1979; Okuyama et al., 1979). Effects may vary from lethal to sublethal and from short term to long term. Nonpolar, hydrophobic pollutants become a special problem for long-distance migrant birds that rely on fat deposits for extra energy requirements. More fat will hold more of that kind of pollutant. Migrants are generally sensitive to airborne toxins because of sustained high ventilation rates required for flight. Indirect effects of air emissions include adverse synergistic effects with other stressors and shifts in food supplies. Acid deposition affects the forest forging habitat of birds. Air emissions may cause changes in bird distribution and abundance, but the emissions must be diagnostically separated from other possible factors (e.g., weather and food supplies) that could have the same effect. **Chapter 4.2.1.1.1** provides an analysis of the effects of the WPA proposed action on air quality and notes that emissions of pollutants into the atmosphere from the activities associated with the proposed action would have minimal effects on offshore and onshore air quality because of the prevailing atmospheric conditions, emission heights and rates, and pollutant concentrations

The impacts of discharges into water vary from short term to long term and from sublethal to lethal. Impacts may be from ingestion or contact (direct) or from the changes in the distribution, composition, or abundance of preferred foods (indirect). Discharges may affect the breeding success of seabird nesting colonies prevalent along the shores of the northern Gulf of Mexico. Maintenance dredging and resuspension of sediment in canals and navigation channels increases turbidity over time. Birds feeding in such waters would likely experience chronic, sublethal impacts.

Habitat and plant substrates can be described as the physical environment used by a bird. Birds select their habitat at various times in their life histories according to their needs. A major negative impact to coastal and marine birds is the loss or degradation of preferred or critical habitat and, for a threatened or endangered species, this may result in global extinction. This discussion applies to both federally listed endangered/threatened bird species and nonlisted species, since the effects are the same or very similar. The extent of bird displacement resulting from habitat loss is highly variable among species, based upon specific habitat requirements, which for many species is poorly understood. As displaced birds move to undisturbed areas of apparently similar habitat, the presence of additional conspecifics may exert additional pressure on the habitat, as a result of intra- and interspecific competition for space or food. Fidelity to coastal and marine bird nesting sites varies from year-to-year along the Gulf Coast. Site abandonment along the northern Gulf Coast has often been attributed primarily to habitat alteration and excessive human disturbance (Martin and Lester, 1991). Many of the overwintering shorebird species remain within specific areas throughout the season and exhibit among-year wintering site fidelity, at least when not disturbed by humans. These species may be especially susceptible to localized impacts, resulting in habitat loss or degradation, unless they move to more favorable habitats when they are disturbed by humans.

Pipeline landfalls and terminals, and other onshore OCS-related construction, can alter or destroy wetland habitat, resulting in displacement of associated avian communities. Seabird nesting colonies are particularly sensitive and should always be avoided by construction activities. Environmental regulations require replanting and restoration of wetlands destroyed by pipelaying barges and associated onshore pipeline installation. However, onshore pipelines cross a wide variety of coastal environments and can therefore affect certain species generally not associated with freshwater, marine, or estuarine systems. The northern Gulf of Mexico and areas inland from it have a large diversity of habitats for a variety of avian species including migrants and breeding and wintering birds. Impacts to coastal habitats from pipeline canals and from navigation canals used by OCS-related service vessels will occur over the long term and may ultimately displace species of birds.

Seabirds ingest plastic objects and other marine debris more frequently than do any other taxon (Ryan, 1990). Interaction with plastic materials may lead to permanent injuries and death. The effects of plastic ingestion may be long-term and may include physical deterioration due to malnutrition; plastics often cause a distention of the stomach, thus preventing its contraction and simulating a sense of satiation (Ryan, 1988). The chemical toxicity of some plastics can be high, posing a hazard in addition to obstruction and impaction of the gut (Fry et al., 1987). Some birds also feed plastic debris to their young, which could reduce fledging success and offspring survival rates. As a result of stress from the consumption of debris, individuals may weaken, facilitating infection and disease; migratory species may then not have the energetic capacity to initiate migration or complete the migration process.

Migrants sometimes arrive at certain platforms shortly after nightfall or later and proceed to circle those platforms (the phenomenon is called a nocturnal circulation event) for variable periods ranging from minutes to hours. Nocturnal circulation around platforms may create acute sublethal stress from energy loss and increase the risks of collision, while stopovers on platforms would reduce energy loss. Routine impacts of platform presence and lighting on trans-Gulf migrants are discussed in the following "Proposed Action Analysis."

Proposed Action Analysis

The transportation or exchange of supplies, materials, and personnel between coastal infrastructure and offshore oil and gas structures is accomplished with helicopters, aircraft, boats, and a variety of service vessels (**Table 3-2**). It is projected that 400,000-900,000 helicopter operations related to proposed WPA Lease Sale 218 would occur over the life of the proposed action; this is a rate of 10,000-22,500 helicopter operations per year. Service vessels would use selected nearshore and coastal (inland) navigation waterways, or corridors, and adhere to protocol set forth by USCG for reduced vessel speeds within these inland areas. It is projected that 76,000-141,000 service-vessel round trips related to proposed WPA Lease Sale 218 would occur over the life of the proposed action; this is a rate of 1,900-3,525 service-vessel trips per year. In laboratory experiments, factors determining an animal's susceptibility to noise-induced damage, such as species, age, auditory range, and recovery process, can be controlled. Memphis State University (1971) mentions "the large, well-done body of literature exploring the effects of noise upon auditory structures and hearing."

Animals exposed intermittently to noise had less impact than animals exposed continuously (Memphis State University, 1971). The extent of noise-induced impacts depends on the intensity, frequency spectrum, duration, pattern of exposure, and individual susceptibility. Noise-induced stress may have increased impacts if combined with other stress. Memphis State University (1971) implies that studies of relatively less intense noise pollution such as that from helicopters and service vessels are few.

Disturbances from OCS-related helicopter or service-vessel traffic to coastal birds can result from the mechanical noise or physical presence (or wake) of the vehicle. This discussion applies to both federally listed endangered/threatened bird species and nonlisted species since the effects are the same or very similar.

The Federal Aviation Administration and corporate helicopter policy advise helicopters to maintain a minimum altitude of 700 ft (213 m) while in transit offshore and 500 ft (152 m) while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft (305 m) over unpopulated areas or across coastlines and 2,000 ft (610 m) over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds.

Flushing from the nest is the only behavioral response in raptors that is known to be correlated with severe impact from helicopter overflights (Awbrey and Bowles, 1990). Flushing may exert its influence by having eggs and young kicked out of a nest, exposed to predators, and potential negative effects of cold or heat stress (inclement weather). Important raptors include the bald eagle and peregrine falcon, recently both federally delisted as endangered or threatened species. These species may exhibit impacts from helicopters similar to other raptors previously studied.

A synthesis of literature on impacts of helicopter and other aircraft overflights on raptors by Awbrey and Bowles (1990) is presented as follows (with additional information from Frid and Dill, 2002).

Sometimes flushing, alertness, and other antipredator responses to nonlethal stimuli should become stronger with repeated exposure to the stimuli (Frid and Dill, 2002). This conclusion is especially important because studies on human disturbance of birds sometimes incorrectly state or imply that birds always become accommodated to noise. Sensitization sometimes occurs instead. For example, loom rate is the rate at which a predator or human disturbance proxy for a predator increases in size as it approaches; loom rate is higher for nearby predators than for distant predators. As multiple exposures to the stimuli at different distances occur, the bird should increase its flight initiation distance to stimuli with higher loom rates because as the bird will associate the high rate with closeness of the predator, becoming sensitized rather than habituated because the bird learns to recognize this high-loom-rate cue to danger of close predator approach (Frid and Dill, 2002).

Flushing has a higher probability early in the breeding season. The cause of this increased likelihood is perhaps later habituation. Habituation occurs when the central nervous system of an individual is presented with a highly repetitious stimulus and eventually no longer responds to the stimulus. Another potential cause is increased attention to nesting as the breeding season proceeds. This increase in parental attentiveness with time could result because as this season progresses, renesting success declines and the cost of parental investment in a first nest increases. The bald eagle and peregrine falcon, cliff and tree nesting raptors, often experience low levels of egg predation, probably less than ground-nesting raptors; flushing may be relatively less important for these two species. "Nonspecific" stimuli, where the bird does not identify (specify) the disturbing stimulus as a human (when the disturbing agent was a car or an aircraft, for example), drive raptors away from feeding areas only briefly

Birds can lose eggs and young when predators attack nests after parents are flushed into flight by service-vessel noise. Overall breeding success (ratio of fledged birds per nest to hatched birds per nest) may be reduced. Chronic effects on breeding are especially serious for endangered or threatened species because subsequent recovery may not be possible or may be delayed. Routine presence and low speeds of service vessels within inland and coastal waterways would possibly reduce the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds.

Contamination of wildlife by air emissions can occur in three ways: inhalation, absorption, and ingestion. Inhalation is the most common mode of contamination for birds (Newman, 1980). Levels of sulfur oxide (mainly SO_2) emissions from hydrocarbon combustion from OCS-related activities are of concern in relation to birds.

The indirect effects of air emissions on wildlife include food web contamination and habitat degradation, as well as adverse synergistic effects of air emissions with natural and other manmade stresses. Air pollutants may cause a change in the distribution of certain bird species (e.g., Newman, 1977; Llacuna et al., 1993).

Chapter 4.1.1.1.2 provides an analysis of the routine effects of the WPA proposed action on air quality. Emissions of pollutants into the atmosphere from the activities associated with the proposed action would have minimum effects on offshore and onshore air quality because of the prevailing atmospheric conditions, emission heights and rates, and pollutant concentrations. The most likely pathway for air pollution to affect birds is through acidification of inland waterbodies and soils, and a subsequent change in trophic structure (Environmental Science & Research Limited, 1998).

Chapters 4.1.1.2.1.2 and 4.1.1.2.2.2 provide an analysis of the effects of the WPA proposed action on water quality. This discussion applies to both federally listed endangered/threatened bird species and nonlisted species since the effects are the same or very similar. Expected degradation of coastal and estuarine water quality resulting from of OCS-related discharges may affect coastal birds directly by means of acute or chronic toxic effects from ingestion or contact, or indirectly through the contamination of food sources or habitat loss/degradation. Operational discharges or runoff in the offshore environment could also affect seabirds (e.g., laughing gulls) that remain and feed in the vicinity of offshore OCS structures and platforms. These impacts could also be both direct and indirect. Many seabirds feed and nest in the Gulf; therefore, water quality may also affect breeding success (measured as the ratio of fledged birds per nest to hatched birds per nest). Produced water is an operational discharge containing hydrocarbons, trace heavy metals, radionuclides, sulfates, treatment chemicals, and produced solids that represents most of the waste discharged from offshore oil extraction production facilities (Fraser et al., 2006). The relationship between produced-water discharge and oil sheens is not well understood. In cold waters, oiled birds (especially divers) lose insulation and may die from hypothermia (Fraser et al., 2006); even contact with thin sheens have the potential to reduce water repellency and insulative characteristics of feathers (O'Hara and Morandin, 2010; see also Stephenson, 1997). The maximum allowable hydrocarbon concentration in the U.S. is an average of 29 mg/L per month for the OCS and specifies a maximum (daily average) of 42mg/L daily; events that may cause sheens (USEPA, 2004, in Fraser et al., 2006, p. 149). Assertions that the dilution potential of the ocean as a receiving environment makes ocean discharge an effective waste treatment for produced water have no supporting evidence. Field evidence that any contact between a bird and oil or oily water would be lethal without rehabilitation is also lacking (Fraser et al., 2006). The null hypothesis that produced water and resulting sheens do not kill birds needs to be tested (Fraser et al., 2006).

Impacts of OCS-related facilities such as pipeline landfalls and gas processing plants may occur. The analysis of the potential impacts to coastal environments (**Chapter 4.1.1.3.2**) concludes that the WPA proposed action is not expected to adversely alter barrier beach configurations significantly beyond existing, ongoing impacts in very localized areas downdrift of artificially jettied and maintained channels. Adverse impacts of pipeline and navigation canals are the most significant OCS-related and proposed-action-related impacts to wetlands that may be used by many species of birds for feeding, cover from predators, or nesting. Birds could suffer from lack of food, increased predation, or impacts on reproduction. Initial impacts are locally significant and largely limited to where OCS-related canals and channels pass through wetlands. For the WPA proposed action, 0-1 new pipeline landfalls (Chapter 4.1.2.1.7 of the Multisale EIS) and 0-1 new gas processing plants (Chapter 4.1.2.1.4.2 of the Multisale EIS) are projected. A new gas processing plant would not be expected to be constructed on a barrier beach. Existing facilities originally built inland may, due to natural erosion and shoreline recession, eventually be located in the barrier beach and dune zone and contribute to erosion there. Erosion may cause loss of vital bird nesting, feeding, and roosting habitat on dunes and beaches. The proposed action may contribute to the continued use of existing gas processing plants.

Coastal and marine birds are susceptible to entanglement in floating, submerged, and beached marine debris; specifically in plastics discarded from both offshore sources and land-derived litter and waste disposal (Heneman and the Center for Environmental Education, 1988). This discussion applies to both federally listed endangered/threatened bird species and nonlisted species since the effects are the same or very similar. It is expected that coastal and marine birds would seldom become entangled in or ingest OCS-related trash and debris as a result of BOEMRE prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics, garbage, and other solid wastes at sea or in coastal waters, went into effect January 1, 1989, and is enforced by USCG.

Each spring, migratory land birds, including neotropical passerines that cannot feed at the water surface or rest there, cross the Gulf of Mexico from wintering grounds in Latin America to breeding grounds north of the Gulf of Mexico. Some birds use offshore platforms as stopover sites for this migration; this may enhance fitness. This discussion applies to both federally listed endangered/threatened bird species and nonlisted species since the effects are the same or very similar.

Migrants sometimes arrive at certain platforms shortly after nightfall or later and proceed to circle those platforms (the phenomenon is called a nocturnal circulation event) for variable periods ranging from minutes to hours. Russell (2005) notes that, "because of the anecdotal nature of our circulation observations, we are reluctant even to speculate about the average duration of participation in circulation or the typical energetic consequences of participating in these events." On the other hand, Weir (1976) states "nocturnal kills are virtually certain wherever a lit obstacle extends into an air space where birds are flying. The magnitude of the kill would be determined by the time of year, location, height, light and cross-sectional areas of the obstacle and weather conditions." Circulations increase the risks for birds to collide with platform structures and with each other. Large attractions to lights and collision mortalities are mostly during overcast nights with drizzle and fog. The attractive effect of lights during cloudy nights is enhanced by fog, haze, or drizzle, when moisture droplets in the air refract the light and greatly increase the illuminated area (Wiese et al., 2001). Starving, exhausted, circulating birds may land on the platforms. Birds that dropped out of nocturnal circulations sometimes became trapped in well-lit interior areas of platforms, and these birds appeared sublethally stressed (Russell, 2005). However, a total of 140 birds on the nine platforms were recorded as dead because of starvation for the entire spring of 2000 study period (Russell, 2005). More detail is presented in Chapter 4.2.1.1.7 of the Multisale EIS. It is projected that 26-41 production structures are projected to be installed as a result of the WPA proposed action (**Table 3-2**). Nocturnal circulation on these platforms is assumed to have minimal and mostly sublethal impacts on migrating bird populations. This conclusion results from the confirmed low mortality from starvation for all birds that landed on the platforms examined by Russell (2005) and from the suggested sublethal stress in birds that dropped out of circulation. The presence of a drilling rig may attract seabird prey (invertebrates and/or fish) to a site, causing an increase in seabird abundance there relative to bird density away from the rig or at the rig during pre-spudding (Baird, 1990). The discharge of human waste from a rig may fertilize the area, leading to increases in seabird prey (Wiese et al., 2001). For some seabirds, such as shearwaters, offshore oil platforms have become sites where otherwise patchy or scarce prey are more predictable and concentrated (Wiese et al., 2001). Storm-petrels and other procellariforms forage at night on vertically migrating bioluminescent prey and are naturally attracted to any kind of light. Storm-petrels often fly directly into lights and flares, resulting in death or injury by impact or burning (Wiese et al., 2001).

Summary and Conclusion

The majority of the effects resulting from routine activities with the WPA proposed action on endangered/nonendangered/and marine birds are expected to be intermittent, of small spatial scale, and short term. The ability to fly will often result in avoidance and quick reestablishment. However, some impacts would be chronic, interfering with the rate of reproduction or the rate of survival. Major impact-producing factors include disturbance by helicopter and service-vessel traffic and associated noise, exposure to or intake of OCS-related contaminants of air and water, displacement of localized groups from degraded habitats, pipeline landfalls and other onshore OCS-related construction, exposure to discarded debris from service vessels and OCS-related structures, and structure presence and associated lighting.

Impacts from pipeline and navigation canals to coastal habitats will occur over the long term and may ultimately displace species. Nocturnal circulation around platforms may create acute sublethal or sometimes sublethal stress from energy loss and increase the risks of collision, while stopovers on platforms would reduce energy loss. Because of regulatory standards for air and water quality (as discussed in **Chapters 4.1.1.1, 4.1.1.2.1, and 4.1.1.2.2**), emissions or produced waters should have a small effect on birds. No significant habitat impacts are expected to occur directly from routine activities resulting from the WPA proposed action because of the distance of most of these activities from shore. Secondary impacts from pipeline and navigation canals to coastal habitats would occur over the long term and could ultimately displace species. These activities would occur whether the proposed action was implemented or not; therefore, the proposed action itself would not increase these secondary impacts to birds.

Although there will always be some level of incomplete information on the effects from routine activities under this proposed action on birds, there is credible scientific information, applied using acceptable scientific methodologies, to support the conclusion that any realized impacts would be generally sublethal in nature and not in themselves rise to the level of reasonably foreseeable significant adverse (population level) effects. Also, routine activities will be ongoing in the proposed action area (WPA) as a result of existing leases and related activities. (In the WPA, there are 1,394 active leases as of June 1, 2011 [USDOI, BOEMRE, 2011]). Within the WPA, there is a long-standing and well-developed OCS Program (more than 50 years); there are no data to suggest that routine activities from the pre-existing OCS Program are significantly impacting sea turtle populations. Therefore, a full understanding of any incomplete or unavailable information on the effects of routine activities is not essential to make a reasoned choice among the alternatives.

4.1.1.12.3. Impacts of Accidental Events

A detailed impact analysis of the coastal and marine birds for the WPA proposed action can be found in Chapter 4.4.8 of the Multisale EIS. Impact analyses for the 181 South Area that includes any new information since publication of the Multisale EIS is presented in Chapter 4.1.9.3 of the 2009-2012 Supplemental EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Background/Introduction

This section discusses impacts to coastal and marine birds resulting from the WPA proposed action. Impact-producing factors include oil spills and oil-spill cleanup. Impact discussions are combined for threatened/endangered birds and nonthreatened/nonendangered birds because physiological impacts of oil spills on individuals are potentially similar for both. However, impacts on individuals are more likely to lead to population impacts, including local extinction for the small populations of listed species.

No peer-reviewed studies of the impacts of oil spills on birds in the Gulf of Mexico, including impacts of cleanup of the spill from the DWH event and long-term impacts on forage food supplies for birds, are now publicly available and nonconfidential. This information is being developed through the NRDA process, which may take many years, and what information NRDA has compiled to date is not publicly available at this time. As there is a process ongoing that may take years, given the realities of the DWH event, cost is not a relevant factor in BOEMRE's ability to obtain this information—it cannot be obtained at this time under any circumstances. The BOEMRE has applied what additional scientifically credible information is available using accepted methodologies as described above. In place of Gulf specific studies, investigations of spills in other areas, mathematical modeling, and laboratory tests (e.g., toxicity tests and veterinarian studies of rehabilitation) are used for insight into DWH impacts on all life history stages of birds. This section on accidental impacts concerns the proposed action only; the DWH event is discussed in relation to bird baseline conditions in the description of the affected environment for birds. Also, this section discusses accidental impacts relative to estimated baseline conditions (**Chapter 4.1.1.12.1**). Although relevant to a discussion of reasonably foreseeable significant adverse impacts, this information is not essential to a reasoned choice among alternatives, given the existing body of scientific evidence related to oil-spill impacts on birds. Although information from the DWH event would be useful, it is not expected to significantly change this existing body of science.

Oil spills represent the greatest potential direct and indirect impact to coastal and marine bird populations. Birds that are heavily oiled succumb to acute toxicity effects shortly after exposure (Clark, 1984; Leighton, 1993).

If the physical oiling of individuals or local groups of birds occurs, some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil would be expected.

The symptoms of oiling are plentiful but are all important because, while resilient or rehabilitated birds may quickly recover, symptoms occurring in many birds may cause reduction or loss of whole populations. Symptoms of contact with the persistent fraction of crude oil may be the most important because that fraction usually has the fate of contacting shallow waters and shorelines and being incorporated into wetland sediments. Small coastal spills, pipeline spills, and spills from accidents in navigable waterways can contact and affect the different groups of coastal and marine birds, most commonly seabirds, divers, marsh and wading birds, waterfowl, and some species of shorebirds. Lightly oiled birds can sustain tissue and organ damage from oil ingested during feeding and grooming or from oil that is inhaled. Birds that are heavily oiled are usually killed. Lighter PAH's like naphthalene, phenanthrene, and anthracene are significantly less volatile and water soluble than hydrocarbons like benzene; however, they are somewhat volatile and water soluble and are more persistent in seawater than compounds like benzene. The lighter PAH's have the greatest impacts on birds because of their persistence and high concentration. They are harmful to cell membranes (White and Baker, 1999), including the highly specialized membranes of nerve cells (Hell and Ehlers, 2008; Byrne and Roberts, 2009) that must function properly for vital behavior to remain adaptive. Thus, low levels of oil could deleteriously affect behavior and therefore could interfere with food detection, feeding impulses, adaptive changes in food preferences and the ability to discriminate between poor versus ideal food sources and ideal sources, predator avoidance, definition and defense of breeding and feeding territories, recognition of family members, and homing of migratory and philopatric species. The toxicity profile for alkylated naphthalene and phenanthrene in birds has not been extensively characterized, but some symptoms have been recorded (Klasing et al., 2007). Naphthalene fed to birds resulted in reduced food consumption, reduced growth rate, and six physiological disorders (Klasing et al., 2007), but some effects on birds have been quantified. Naphthalene had no impact on several reproductive traits, internal organs, and 12 blood parameters (Klasing et al., 2007). Systemic inflammation did not happen. For chicks hatched from eggs of Japanese quail hens that had ingested naphthalene, growth rate, mortality, and two blood parameters were unaffected (Klasing et al., 2007).

The mandatory use of waterbird feeding areas at the sea surface and intertidal wetland zone, where spilled oil tends to accumulate, makes the birds vulnerable to exposure to oil. Wetland sediments have low oxygen diffusion rates and are waterlogged, and therefore, not aerated with oxygen-rich air; hence, they have low redox potential (Mitsch and Gosselink, 2007). Oxygen has a very low rate of diffusion from the atmosphere through pore water in waterlogged sediment. Oil would also diffuse very slowly through pore waters to reach the sediment-water interface. Therefore, when oil gets into vegetated or unvegetated sediment, low redox potentials (from reduced oxygen availability and oxygen loss through bacterial respiration) and absence of light may result in oil that can neither be oxidized by bacteria and sunlight nor reach the sediment-water interface and evaporate. The oil may also remain in its unweathered toxic state indefinitely. However, weathering-related effects on the oil on its the path to the coast ameliorates, to some extent, toxicity at the shoreline. If physical oiling of individuals or local groups of birds occurs, some degree of both acute and chronic physiological stress associated with direct and secondary uptake of oil would be expected. Affected individual birds may initially appear healthy at first, but they may be affected by physiological stress that does not occur until much later. Biochemical impacts of lighter PAH's have not been extensively described, but they could possibly include increased susceptibility to physiological disorders, including all sorts of disruption of homeostasis, weakened immune systems and reduced resistance to disease, and disruption of respiratory functions (Nelson and Cox, 2008; Briggs et al., 1996). The internal biochemical environment of the bird has a large number of components, interactions, and functions (Nelson and Cox, 2008) that may provide potential points of attack from petrochemicals. The network and feedback system nature of the internal environment (Nelson and Cox, 2008) also provides routes by which an effect on one process can lead to cascading sublethal, chronic effects and a myriad of interconnected problems.

Under natural conditions, water does not penetrate through the vanes of the feathers because air is present in the tiny pores in the lattice structure of the feather vane. Birds swimming in dispersant had reduced buoyancy and water penetration through the feathers. Dispersants reduce water surface tension in the feather lattice pores (they have a surfactant component) and render them water attracting instead of water repelling (Stephenson, 1997; Stephenson and Andrews, 1997). Beginning at a certain surface tension, water would penetrate the pores of the feathers, and death from reduced thermoregulatory function hypothermia may result (Lambert et al., 1982; Stephenson, 1997; Stephenson and Andrews, 1997). Dispersants alone cause water penetration of the feathers (Lambert et al., 1982) by reducing the surface tension of the water in the pores of the lattice. A much smaller minimum volume (1/100) of oil treated with Finasol OSR-5 dispersant, relative to the volume of untreated oil, was required to produce a substantial effect on plumage insulation and thermoregulation in eiders (Jenssen, 1994). Even with a healthy, water-repellant plumage, waterfowl and seabirds living at medium to high altitudes would, for most of the year, require an augmented resting metabolic rate when floating on the water surface, due to water's relatively high heat conductance and water pressure on the feathers provided by the buoyant force on the bird (Stephenson, 1997). In other words, even unoiled feathers do not provide complete insulation against cold.

Ingestion of oil by birds may affect reproductive ability, cause anemia, result in reduced eggshell thickness that promotes cracking under the weight of an incubating parent, and cause four physiological disorders (Fry et al., 1986; Butler et al., 1988; Velando et al., 2005a and 2005b; Zuberogoitia et al., 2006; Zabala et al., 2010; Szaro et al., 1978a and 1978b; Lambert et al., 1982; Rocke et al., 1984; Leighton, 1993; Fowler et al., 1995; Alonso-Alvarez et al., 2007a; Perez et al., 2010).

External oiling of eggs may slow embryonic growth, induce tumor growth, reduce gas conductance through the eggshell, and decrease hatchability (Jenssen, 1994). Impacts on vital life history characteristics such as growth rates (Szaro et al., 1978a and 1978b; Trivelpiece, et al. 1984) or reproductive parameters such as reproductive success may occur, resulting in possible local population extinction. Indirect effects occur by fouling of the nesting habitat and displacement of individuals, breeding pairs, or populations to less favorable habitats (e.g., Velando et al., 2005b). Competition may exclude refugee seabirds from all habitats, especially for seabird colonies in southeastern Louisiana.

A mathematical model by Peakall et al. (1989) showed that exposure to a slick at the surface (which would usually reduce in size or vanish in response to chemical dispersants) was the sensitive pathway to contamination in seabirds. Exposure to oil in the water column (a primary destination of chemically dispersed oil from surface slicks, along with the seafloor) was modeled to be minor. Sometimes, because of lack of thorough training of all personnel or the sheer scale of operations, the air, vehicle, and foot traffic that takes place during shoreline cleanup may disturb nesting populations and degrade or destroy habitat.

New research, experience, and testing will help the efficacy of the rehabilitation of oiled birds and will probably improve scare methods that will keep birds away from an oil slick. Rehabilitation can be significant to the survival of threatened and endangered bird species. Chemically dispersed oil has sublethal biochemical and physiological toxicity to seabirds similar to that of oil alone (Peakall et al., 1987). Dispersant contact with birds is unlikely because dispersant, including that applied to the sea surface, has a fate that is similar to dispersed oil. It is mixed into the water column well below the sea surface where its concentration is extremely diluted, even from the point of view of a seabird diving into the water column for food. Wave action may remove all dispersed oil from a slick into the water column, well below the sea surface where contact with birds is more of an issue. Toxic effects of untreated and chemically dispersed oil on the hatching success of waterfowl and seabirds were similar (NRC, 1989).

Preening of oiled plumage may drive oil deep into plumage (Jenssen, 1994; Jenssen and Ekker, 1991). Birds that must feed on or in the water lose heat faster than semiaquatic birds that can feed with a dry plumage on land (Jenssen, 1994). Some aquatic birds such as cormorants, when oiled, must either starve on land or enter the sea where hypothermia would kill them (Jenssen, 1994).

Residual material that remains after evaporation and solubilization is water-in-oil emulsions (mousse), which are the primary pollutant onshore after offshore spills. The mixing of mousse and sediments form aggregates that have the odor of oil and, after photo- and biological oxidation, form asphaltic "tarballs" and pavements (Briggs et al, 1996). Mousse emulsions may be the most toxic petroleum component because they are the most hydrophobic and would penetrate the hydrophobic core of the plasma membrane of cells and would cause disruption of the membrane and enter the cells as well (Briggs et al., 1996). Common symptoms of exposed birds include dehydration, gastrointestinal problems, infections, arthritis, pneumonia, hemolytic anemias, cloacal impaction, and eye irritation. Therefore, antibiotic treatments, nutritional support, rehydration, and other protocols are used at rehabilitation centers (Briggs et al., 1996). Capture-recapture methods to calculate survival may work better for waterfowl than for seabirds because of extremely low encounter rates in seabirds (Dunne and Miller, 2007). Capture-recapture data for the 30-year period 1974-2004 and for the 11-year period 1993-2004 demonstrated that oiling and subsequent rehabilitation do not have an effect on post-release survival in mallards compared with the survival of unexposed birds, meaning that rehabilitation was effective (Dunne and Miller, 2007). In the same study, for Canada geese, data from an unfavorable, aberrant release site were excluded and oiling and rehabilitation had no effect on post-release survival (Dunne and Miller, 2097). Rehabilitation may even give a higher probability of survival to Canada geese than unoiled controls because rehabilitation provides consistent access to food, a brief protection from predators, and general health management practices (Dunne and Miller, 2007). Standard blood parameters of birds brought to rehabilitation centers were first measured in the mid-1970's. About 12 parameters, including effects on both red and white blood cells, were involved (Briggs et al., 1996). The metabolic rate, correlated with heat loss, was not substantially increased by chemically dispersed oil relative to the increase caused by oil alone (Lambert et al., 1982). Oiled birds spend more time preening off the water, exposing them to predation and reducing the time available for feeding, breeding, and other activities (Stephenson and Andrews, 1997). Some body cells respond to oil with excessive deposition of a yellow-brown pigment, hemosiderin, causing hemosiderosis (Briggs et al., 1996). Impacts of oil on the immune system include inflammation of the gastrointestinal tract following oil ingestion, which affects the intestinal mucosa lining. The mucosa functions in immune defense and in suppression of immune response to certain antigens such as those in foods.

Mallards exposed to cold temperature stress had increased mortality rates if they were fed with oil, which caused seriously increased stress from release of corticosteroid stress hormone caused by the oil (Briggs et al., 1996).

The immune system has a large number of components, interactions, and functions that can provide potential targets for petrochemicals. The network nature of the system also provided a pathway by which an effect on one component can lead to a myriad of other interconnected problems (Briggs et al., 1996). These authors note, "A complete understanding of how the immune system works, including a finished roster of its components, is far from achieved."

Burger (1993) notes that spill volume has little or no correlation with bird mortality. Similarly, Camphuysen et al. (2005) found that, for six major spills in Western Europe, spill volume (ranging from 170 tonnes of heavy fuel for the *Tricolor* to 223,000 tonnes of crude for the *Amoco Cadiz*) was not correlated with estimated bird mortality. In a comparison study with similar results (Kingston, 1995), the *Braer* spilled 85,000 tonnes but killed only about 4,000 birds, while the *Exxon Valdez* spilled only 35,000 tonnes but killed about 100,000-300,000 birds. The state of the seas at the time of the *Exxon Valdez* accident was calm and the oil was heavy, high-viscosity crude, resulting in little capability for chemical or natural dispersal. In comparison, the *Braer* oil was light crude and seas were heavy, creating a large potential for dispersal. Because of its undispersed state, the *Exxon Valdez* oil principally affected surface-dwelling and shore-dwelling organisms such as birds. The *Braer* oil did not even moderately affect shores, and because of the dispersed state of the oil, it affected only sea bed and pelagic water column biota and killed very few birds. However, Wilhelm et al. (2007) shows that the lack of correlation of bird mortality with spill volume no longer holds when spill volume is scaled as the perimeter of the oil slick by putting a fractional exponent on spill volume (see also Tan et al., 2010). An estimated 10,000 seabirds were killed in a 1,000-bbl spill from the FPSO *Terra Nova* vessel off the Grand Banks of Newfoundland on November 21, 2002. No birds could be counted on the beach because winds blew out to sea, and no seabird data were available from before the spill. Even so, birds inside and outside the slick area were counted from a ship at sea while the slick was on the water. The density of seabirds in the affected area, timing (i.e., if peak periods in bird density overlap temporally with the spill), wind conditions, wave action, and distance to the shore may have more effect than spill volume (Castege et al., 2007; Byrd et al., 2009). Long-term impacts of the *Sea Empress* spill (72,000 tonnes of crude) in Wales were moderate; in a 10-year study (Moore, 2006), the numbers of the majority of affected breeding seabird colonies (primarily alcids) recovered to pre-spill values within 2-3 years. Localized effects on the distribution of migratory wetland birds were not evident after 2 years. Khan and Ryan (1991) note substantial mortality in seabirds after attempts at rehabilitation (see also Anderson et al., 1996; Sharp, 1996). Sublethal symptoms of contamination were numerous and substantial prior to the mortality. Similarly, numerous symptoms were found in dead birds on the shore and in birds dying after rehabilitation; these bird were affected by the *Prestige* oil spill off the coast of Spain on November 19, 2002 (Camphuysen et al., 2002; Balseiro et al., 2005; Velando et al. 2005a; Zuberogoitia et al. 2006; Perez et al. 2008; Zabala et al., 2010). Final major impacts to European shags (*Phalacrocorax aristotelis*) from the *Prestige* spill probably came in 2003 from a decimated food supply of fish (Velando et al., 2005b). As oil weathered, the exposure of seabirds to oil from the *Exxon Valdez* spill shifted from direct oiling to ingestion with food (Hartung, 1995).

Alonso-Alvarez et al. (2007a and 2007b) used blood chemistry of yellow-legged gulls (*Larus michahellis*) to compare long-term sublethal toxicity of the *Prestige* oil spill with short-term experimental sublethal toxicity in captive birds fed small amounts of fuel oil. Long-term effects were measured about 19 months after the spill. Short-term effects were measured in captive birds fed a small amount of fuel oil for 7 days. Adults from oiled colonies and fuel-oil-fed experimental birds had higher total PAH's and lower levels of three natural metabolites. Calcium was lower in oil-fed females than in control females, but it was the same in oil-fed and control males. Calcium is important for sufficient egg shell thickness in breeding females.

Parsons (1994) provides the following unique before and after data for impacts of a spill on birds. Extensive shoreline and salt marsh were oiled by a January 1990 Exxon spill in the Arthur Kill and Kill van Kull estuaries of New York Harbor. Double-crested cormorants had reached their pre-spill population growth by 1991. Productivity of herring gulls remained unchanged by the spill. Most heron populations increased after the spill. Great black-backed gulls had a loss of abundance. Snowy egrets and glossy ibis used salt marsh and mud flat habitat, some of which was oiled. Black-crowned night heron and glossy ibis had delayed nesting after the spill and, along with snowy egret, showed lower reproductive success after the spill. Egg laying and hatching were generally more successful than chick-rearing because of the shortage of food fed to the chicks. Waterfowl abundance was not affected seriously, except for a short-term decline in mallards. For waterfowl, beached bird numbers and changes in abundance were the only data collected.

The new information does not conflict with information in the Multisale EIS and the 2009-2012 Supplemental EIS, and often it is similar to or supports the information in these two documents. The baseline for the following analysis is presented in the description of the affected environment (**Chapter 4.1.1.12.1**).

Proposed Action Analysis

The probabilities of oil spills ≥1,000 bbl occurring and contacting coastal bird habitat within 10 days as the result of the proposed action over 40-year leasing scenario are 7-11 percent for the threatened piping plover; 1 percent for the endangered whooping crane; 8-13 percent for the brown pelican; 8-13 percent for raptors; 8-14 percent for gulls, terns, and charadriid allies; 8-14 percent for shoreline charadriids; 8-13 percent for diving birds; 8-14 percent for wading birds; and 9-14 percent for waterfowl. All of these groups, except for the whooping crane and piping plover, are widely distributed across the Gulf (Figures 4-22 through 4-31 of the Multisale EIS); therefore, an oil spill would only affect a small portion of a bird group. The combined probabilities are always <15 percent. Impacts to birds are discussed in detail above in this section, extrapolating to the Gulf of Mexico from spills in other areas and from laboratory tests and mathematical modeling. Most bird populations affected by a spill would be expected to recover to pre-spill abundances within months to years after the spill. For most species, abundant populations well outside of any oil-spill area would survive impacts with no impacts at all. Nevertheless, random fluctuation in the small populations of the listed species, combined with impacts from an accidental event, could result in local population extinction. Small coastal spills, pipeline spills, and spills from accidents in navigable waterways can contact and affect the different groups of coastal and marine birds, most commonly marsh birds, waders, waterfowl, and certain shorebirds. In the WPA, an estimated total of 15-34 coastal spills would occur over a 40-year production period. However, 13-29 of these spills would be ≤1 bbl and only 0-1 spills would be ≥1,000 bbl. Impacts on seabirds at sea are not part of the modeling analysis because their large seasonal and spatial distribution throughout the Gulf is too large to have been characterized at this point and to be useful in the model run. Many species breed outside the United States, sometimes outside the Northern Hemisphere, so they would be vulnerable to any outside impacts as opposed to just those in the WPA or Gulf of Mexico. Impacts of the WPA proposed action on all coastal birds are expected to be negligible because any reductions in populations likely would not be sustained. Oil-spill cleanup is not expected to affect coastal birds if all personnel are completely trained, reducing the potential impacts from the scaring of feeding, roosting, or nesting birds or from the destruction of nests. Reduced impacts of oil slicks after dispersant application would likely more than offset the impacts from dispersants and chemically dispersed oil, which do not remain on the sea surface where they would contact birds or bird shoreline habitat.

Summary and Conclusion

Oil spills may have serious direct and indirect impacts to coastal and marine bird health and habitat for feeding, roosting, sleeping, and nesting. In shallow water, such spills would have impacts on birds directly through contamination of skin and plumage, interfering with their ability to maintain body temperature, buoyancy, waterproofing, and the ability to fly. Impacts on individuals are much more serious for populations of endangered or threatened species (such as the piping plover and the whooping crane) than for nonlisted species because low populations of listed species may be more likely to face extinction because of the disappearance of a relatively small number of individuals. The lighter PAH's have the greatest impacts on birds because of their persistence and high concentration. They are harmful to cell membranes. The mandatory use of waterbird feeding areas at the sea surface and intertidal wetland zone, where spilled oil tends to accumulate, makes the birds vulnerable to exposure to oil. Exposure to oil in the water column was modeled to be minor. When oil gets into vegetated or unvegetated sediment, it may remain in its unweathered toxic state indefinitely. However, oil weathering as it travels to the coast ameliorates toxicity at the shoreline. Small amounts of oil can affect the health of birds. Birds may have reduced reproductive effort, causing temporary declines in population abundance. Mortality from oil spills is often related to numerous symptoms of toxicity. Data from actual spills strongly suggest that impacts on their food supply are delayed after initial impacts from direct oiling. With properly trained and supervised personnel, impacts of oil-spill cleanup from the proposed action are also expected to be negligible. Although a catastrophic event like the DWH event remains a remote possibility, such a large-scale effort could increase the potential impacts from oil-spill cleanup.

Among accidental events related to the proposed action, oil spills have the greatest potential to impact coastal and marine bird populations. Nevertheless, oil-spill impacts on birds from the WPA proposed action are expected to be negligible because an oil spill would only affect a small portion of a bird group (combined probabilities are always <15%), not rising to the level of populations impacts. An exception would be the piping plover, where impact on a small number of birds could considerably reduce a population. The piping plover is in low abundance but its wintering habitat is plentiful in the Gulf of Mexico. An oil spill would likely only contact a small portion of this wintering habitat in the GOM; thus, the greatest threats to the recovery of the piping plover remain at its breeding habitat in the Great Plains and Great Lakes, not the OCS Program or this proposed action.

4.1.1.12.4. Cumulative Impacts

A detailed impact analysis of the coastal and marine birds for the WPA proposed action can be found in Chapter 4.5.8 of the Multisale EIS. Impact analyses for the 181 South Area that includes any new information since publication of the Multisale EIS is presented in Chapter 4.1.9.4 of the 2009-2012 Supplemental EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Background/Introduction

This cumulative analysis considers impact-producing factors that may adversely affect populations of nonendangered/nonthreatened and endangered/threatened birds related to OCS and non-OCS activities. Both listed and nonlisted birds are discussed together because the impacts are similar.

The OCS activities include the following:

- the proposed action; and
- prior and future OCS sales.

The non-OCS activities include the following:

- State oil and gas activity;
- crude oil imports by tankers; and
- other commercial, military, and recreational offshore and coastal activities.

The OCS-related, impact-producing factors include the following:

- air emissions;
- degradation of water quality;
- platform and pipeline oil spills and any improperly directed spill-response activities;
- structure presence and lights;
- aircraft and vessel traffic and associated noise, including OCS helicopter and service-vessels;
- habitat loss and modification resulting from coastal facility construction and development;
- OCS pipeline landfalls; and
- trash and debris.

The non-OCS, impact-producing factors include the following:

- air emissions;
- pollution of coastal waters resulting from municipal, industrial, and agricultural runoff and discharge;
- tanker oil spills and spills related to oil and gas activities in State coastal waters and any improperly directed spill-response activities;
- aircraft and military activities, including jet training overflights and sonic booms;
- nonconsumptive recreation, including bird-watching activities;
- maintenance and use of navigation waterways;
- collisions of coastal and marine birds with wind turbines, communication towers, lighted structures, tall buildings, windows, power lines, and fences;
- disease;
- storms and floods;
- coastal development; and
- fisheries interactions (negative impacts of decreased food resources by fisheries catch and incidental seabird bycatch, and positive impacts of increased food resources from discarded bycatch).

Proposed Action Analysis

OCS-Related and Non-OCS-Related Air Emissions

Chapter 4.2.1.1.7 of the Multisale EIS and **Chapter 4.1.1.12.2** of this Supplemental EIS provide an overview of air pollution pathways and impacts on birds. As described there, air pollution may cause physiological impairment and further lead to diseases. Impacts may include direct mortality, debilitating injury, disease, physiological stress, anemia, hypocalcemic condition, bioaccumulation of air pollutants with associated decrease in resistance to debilitating factors, and population declines and changes in distribution. Effects may vary from lethal to sublethal and from short term to long term.

Air emissions include the amount of sulfur dioxide expected to be released due to the proposed action, as well as from prior and future OCS sales, and State oil and gas activity. These emissions may adversely affect coastal and marine birds. Pollutant emissions into the atmosphere from the activities under the cumulative analysis are projected to have minimum effects on offshore air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Onshore impact on air quality from emissions under the OCS cumulative analysis is estimated to be within both Class I and Class II PSD allowable increments as applied to the respective subareas. Emissions of pollutants into the atmosphere under the cumulative analysis are projected to have little effect on onshore air quality because of the atmospheric regime, the emission rates, and the distance of these emissions from the coastline. These judgments are based on average steady state conditions and the dispersion equation for concentration estimates; however, there would be days of low mixing heights and wind speeds that could further decrease air quality. These conditions are characterized by fog formation, which in the Gulf averages about 30-40 days a year, mostly during winter. Impacts from offshore sources are reduced in winter because the frequency of onshore winds decreases and the removal of pollutants by rain increases. The summer is more conducive to air quality effects as onshore winds occur more frequently. Increases in onshore annual average concentrations of NO_x, SO_x, and PM_{10} under the cumulative analysis are estimated to be less than Class I and Class II PSD allowable increments for the respective subareas per both the steady state and plume dispersion analyses, and they are below concentrations that could harm coastal and marine birds. Indirect impacts on coastal and marine birds due to air quality under the cumulative analysis would have a negligible effect on coastal and marine birds.

OCS-Related Impacts

Degradation of Water Quality

Water quality of coastal environments would be affected by bilge water from service vessels and point- and nonpoint-source discharges from supporting infrastructure. Water quality in marine waters would be impacted by the discharges from drilling, production, and platform removal operation operations. Degradation of coastal and inshore water quality resulting from factors related to the proposed action plus those related to prior and future OCS sales; crude oil imports by tanker; and other commercial, military, and recreational offshore and coastal activities is expected to impact coastal and marine birds. As described in Chapter 4.5.8 of the Multisale EIS, toxic effects on birds from impaired water quality could include survival, loss of habitat and food sources, and reproduction.

Platform and Pipeline Oil Spills and Any Improperly Directed Spill-Response Activities

Oil spills have the greatest potential to impact coastal and marine birds. Mandatory use of waterbird feeding areas at the sea surface and intertidal wetland zone, where spilled oil tends to accumulate, makes the birds extremely vulnerable to exposure to oil. Exposure to small amounts of oil may have a latent impact on birds and a delayed impact on their food supply. Mortality from oil spills is often related to numerous symptoms of toxicity. Oil-spill impacts on birds from the WPA proposed action are expected to be negligible. For coastal spills ≥1,000 bbl, the estimated total number of spills is 1 per 6 years from the total of OCS sources; for offshore spills ≥1,000 bbl, the estimated total number of spills for OCS sources is ≤1 per year for facilities and 1 per year for pipelines (Chapter 3.2.1 of the 2009-2012 Supplemental EIS).

Structure Lights and Presence

Every spring, migratory terrestrial birds, including neotropical passerines, cross the Gulf of Mexico from wintering grounds in Latin America to breeding grounds north of the Gulf of Mexico. Terrestrial birds cannot stop over to feed on the water so they must have the energy to fly non-stop across the Gulf of Mexico. Migrants sometimes arrive at certain platforms shortly after night fall or later and proceed to circle those platforms (the phenomenon is called a nocturnal circulation event) for variable periods ranging from minutes to hours. Nocturnal circulation around platforms may create lethal effects from platform collision or may cause acute sublethal stress or death from exhaustion, while stopovers on platforms could reduce energy loss.

Aircraft and Vessel Traffic and Noise from Helicopters and Service Vessels

Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat. The Federal Aviation Administration (Advisory Circular 91-36C) and corporate helicopter policy states that helicopters must maintain a minimum altitude of 700 ft (213 m) while in transit offshore and 500 ft (152 m) while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft (305 m) over unpopulated areas or across coastlines and 2,000 (610 m) ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. The net effect of OCS-related flights on coastal and marine birds is expected to result in sporadic disturbances, which may result in displacement of localized groups. During nesting periods, this could ultimately result in some reproductive failure from nest abandonment or predation on eggs and young when a parent is flushed from a nest.

Service vessels would use selected nearshore and coastal (inland) navigation waterways and would adhere to protocol set forth by USCG for reduced vessel speeds within these inland areas. Routine presence and low speeds of service vessels within these waterways diminish the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. It is expected that service-vessel traffic would seldom disturb populations of coastal and marine birds existing within these areas. Recreational vessel traffic is a much greater source of impact to birds in coastal habitats. These vessels are, in most cases, required to comply with strict speed/wake restrictions (small recreational fishing boats, ski boats, etc.) but often flush coastal and marine birds from feeding, resting, and nesting areas. Such disturbances displace local groups from these preferred habitats and could lead to abandonment of the areas in general or reproductive failure. Disturbance may result in increased energy expenditures due to avoidance flights and decreased energy intake due to interference with feeding activity. It is estimated that the effects of non-OCS vessel traffic on birds within coastal areas are substantial.

In laboratory experiments, factors determining an animal's susceptibility to noise-induced damage, such as species, age, audibility range, and recovery process, can be controlled. Memphis State University (1971) mentions "the large, well-done body of literature exploring the effects of noise upon auditory structures and hearing." Hearing loss or damage to the auditory system from noise has been reported in laboratory mammals (Memphis State University, 1971).

Habitat Loss and Modification Resulting from Coastal Facility Construction and Development

Under the cumulative activities scenario, factors contributing to coastal landloss or modification include construction of 0-1 gas processing plants, as well as other facilities. Although construction of this potential gas processing plant would necessitate some associated habitat loss, the contribution of development from non-OCS-related urban and other industrial growth would be substantial in comparison, causing both the permanent loss of lands and increased levels of disturbance associated with new construction and facilities. A large variety of wild birds usually cannot exist in suburban or urban areas.

Pipeline Landfalls

Under the cumulative activities scenario, factors contributing to coastal landloss or modification include construction of approximately 11 OCS-related pipeline landfalls (**Chapter 3.1.2.3**) from 2007 to 2046 in the WPA. Adverse impacts of pipeline canals are the most significant OCS-related and proposed action related impacts to wetlands. Initial impacts are locally significant and largely limited to where OCS-related canals pass through wetlands. Pipeline canal dredging will occur in wetland bird habitat and, without mitigation, wetland habitat could be destroyed. Impacts to birds would be indirect (loss of wetland, feeding, and nesting habitat). The regulatory apparatus for the mitigation of pipeline canal dredging in wetlands is managed by COE. Mitigation would likely prevent substantial impacts on wetland bird populations. Mitigation includes avoidance, restoration, use of existing pipeline corridors, back-filling, directional drilling, push-pull trenchless pipeline installation, and careful dredge spoil disposal to avoid blocking water flow across wetlands.

Trash and Debris

Coastal and marine birds would likely experience chronic physiological stress from sublethal exposure to or intake of contaminants or discarded debris. This would cause disturbances and displacement of single birds or flocks. Chronic sublethal stress is often undetectable in birds. It can serve to weaken individuals (especially serious for migratory species where individual impacts may reach population impacts), making them susceptible to infection and disease. Coastal and marine birds are commonly entangled and snared in discarded trash and debris. Many species would readily ingest small plastic debris, either intentionally or incidentally. Interaction with plastic materials may lead to permanent injuries and death. Much of the floating material discarded from vessels and structures offshore drifts ashore or remains within coastal waters. These materials include lost or discarded fishing gear such as gill nets and monofilament lines, which cause the greatest damage to birds. It is expected that coastal and marine birds would sometimes become entangled in or ingest OCS-related trash and debris, but impacts would be considerably reduced as a result of BOEMRE prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, went into effect January 1, 1989. Despite these regulations, quantities of plastic materials are accidentally discarded and lost in the marine environment, and so a threat to individual birds remains within these areas.

Non-OCS-Related Impacts

Habitat Degradation

The contribution of development from urban and industrial growth will be substantial because of an expanding economy, causing both the permanent loss of lands and increased levels of disturbance associated with new construction and facilities. Habitat alteration has the potential to disrupt social behavior, food supply, and the health of birds that occur in the Gulf of Mexico. Real estate development in coastal and other habitats may stress the animals and cause them to avoid traditional feeding and breeding areas or migratory routes. Many of these species are declining in numbers and are being displaced from areas along the coast (and elsewhere) as a result of the destruction of or encroachment on their preferred habitat(s). As these birds move to undisturbed areas of similar habitat, their presence may create or augment habitat utilization pressure on these selected areas as a result of intra- and interspecific competition for space and food.

Tanker Oil Spills and Spills Related to Oil and Gas Activities in Coastal State Waters and Any Improperly Directed Spill-Response Activities

Most offshore non-OCS-related spills occur from vessel and barge operations. Table 4-13 of the Multisale EIS lists annual oil spill occurrence in the Gulf of Mexico. Based on the 2009-2012 Supplemental EIS's OSRA model for coastal spills $\geq$1,000 bbl, the estimated total number of spills is 3 per 6 years for the total of non-OCS sources; for offshore spills $\geq$1,000 bbl, the estimated total number of spills for non-OCS sources is $\leq$1 per year for tank ships and $\leq$1 per year for tank barges. In summary, mandatory use of waterbirds feeding areas at the sea surface and intertidal wetland zone, where spilled oil tends to accumulate, makes them extremely vulnerable to exposure to oil. Exposure to small amounts of oil may have a latent impact on birds and a delayed impact on their food supply. Mortality from oil spills is often related to numerous symptoms of toxicity. Oil spills from non-OCS Program-related vessels in the cumulative case have the greatest potential to impact to coastal and marine birds. Impacts of several tanker spills are summarized in **Chapter 4.1.1.12.3**. On the basis of this analysis and the OSRA model results, the combination of low probability of occurrence of a large spill and low probability of contact of such a spill with substantial amounts of the shoreline, oil-spill impacts on birds from the total cumulative scenario are expected to be moderate. The increment of oil spills from the WPA proposed action to the total cumulative impacts of all potential spills (including those not related to the OCS Program) is expected to be negligible because OSRA shows a low probability of OCS Program-related spill occurrence and shoreline habitat contact. This spill impact is not substantially altered by possible tanker spills. Tanker spills may have moderate impacts because of the vast expanse of shoreline habitat that would be unlikely to be contacted by any import tanker spill and could serve as a refuge habitat for bird species from the spill.

Pollution of Coastal Waters Resulting from Municipal, Industrial, and Agricultural Runoff and Discharge

Non-OCS-related activities and natural processes that can impact marine water quality include bilge water discharges from large ships and tankers, and coastal pollutants that are transported away from shore, including runoff, river input, sewerage discharges, industrial discharge, and natural seepage of oil and gas. Some pollutants will have lethal or sublethal impacts on birds. The level of impact depends on the frequency, location, season, and quantity of pollutant discharges. There exists a wide variety of contaminant inputs into coastal waters bordering the Gulf of Mexico. Contaminants from non-OCS pollution of coastal waters resulting from municipal, industrial, and agricultural runoff and discharge may have acute or chronic, lethal, or sublethal impacts. The principal source of contaminants that impair coastal water quality is urban runoff, which includes heavy metals, oil, grease, and pesticides that are toxic to birds. The dominant pollution source is the large volume of water from the Mississippi River, which drains over two-thirds of the contiguous United States. Major activities that have added to the contamination of Gulf coastal waters include the petrochemical industry, agriculture, forestry, urban expansion, extensive dredging operations, municipal sewerage treatment processes, marinas and recreational boating, maritime shipping, and hydromodification activities. Such contamination may have lethal or sublethal impacts on birds, such as by pesticides used in agriculture, excess nutrients in treated sewage discharge, and motor oil discharged into municipal storm sewers. Not as significant are large commercial waste disposal operations, livestock farming, manufacturing industry activities, power plant operations, and pulp and paper mills. Vessel traffic is likely to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and domestic and sanitary discharges. The overall toxic effect of all organic pollutants and heavy metals could reduce population size in vulnerable species of birds.

Aircraft and Military Activities Including Jet Training Overflights and Sonic Booms

Playback of aircraft overflight noise at 96 decibels (dB) inside incubators and at 131 dB outside a different kind of incubator did not substantially affect the hatchability of chicken eggs or the quality of hatched chicks. Playback of overflight noise of about 115 dB made hens stop sitting on eggs (Stadelman, 1958). Responses to sonic booms in chickens, young turkeys, and pheasants were less intense than low subsonic overflights (Bell, 1972). No effects of subsonic aircraft on nesting herring gulls were noted (Burger, 1981). Subsonic aircraft overflights flushed significantly more herring gulls than flushed immediately before or after the disturbances (Burger, 1981). Although not all species resident in the WPA were identified in these studies, those species studied are likely representative for potential impacts to birds in general. Aircraft noise may have impacts on coastal and marine birds in the WPA, but quantitative ranges of noise for aircraft and military operations specifically measured in the WPA were not identified.

Nonconsumptive Recreation

Impacts of nonconsumptive recreation depend on many factors, including species and type of recreation. Nonconsumptive recreation includes activities such as bird watching, boating, and nature photography that do not harvest wildlife. Quantitative data specific to the Gulf of Mexico on the extent of various types of nonconsumptive recreation was not identified. Even visitation by those most interested in conserving wildlife can have detrimental effects (Carney and Sydeman, 1999). Visitation of nesting areas can generate conservation interest and money, but disturbance can cause birds to abandon a site that managers need to preserve (Carney and Sydeman, 1999). Most studies of the effects of visitors on waterbirds did not identify mechanisms of impact, determine relative effects of different kinds of disturbance, or control for confounding influences (Carney and Sydeman, 1999). Impacts had to be extrapolated from studies of avoidance of human disturbance caused by adaptations, such as flocking for predator avoidance.

Recreational vessel traffic is a much greater source of impact to birds in coastal habitats. These vessels are, in most cases, required to comply with strict speed requirements (small recreational fishing boats, ski boats, etc.) but often flush coastal and marine birds from feeding, resting, and nesting areas. Such disturbances displace local groups from these preferred habitats and could lead to abandonment of the areas in general or reproductive failure. Disturbance may result in increased energy expenditures due to avoidance flights and decreased energy intake due to interference with feeding activity. No quantitative data were found on recreational use of coastal areas by non-OCS vessel traffic.

Some ornithologists have presumed that birds that do not fly in response to disturbance are seldom substantially stressed, but this hypothesis has not been tested. Cardiac response is vital for birds that stay put instead of flying but still maintain increased vigilance, are highly stressed, and may be expending large amounts of energy because of elevated metabolic rate. Behavior is an obvious event, which is why it is so often measured, but it does not always signify fitness costs of disturbance or relative fitness costs for different species or populations (Beale, 2007). A decision to avoid a type of behavior may be important. Birds may decide not to flee when fitness costs are greater than the fitness benefits of moving to alternative habitat (Gill et al., 2001). The decision should depend on the context that the bird-alternative habitat may be lacking or scarce, and frequent disturbances could cause frequent flights, creating severe fitness (energy) costs such as lost foraging time during flight and the energy cost of flight. Decisions to shift habitat should be constrained by the species' perceptual range, i.e., the distance from which individuals can perceive landscape elements (Frid and Dill, 2002). Energy reserve depletion is likely to affect reproductive effort and possibly population viability.

Sometimes flushing, alertness, and other antipredator responses to nonlethal stimuli should become stronger; the bird should become sensitized with repeated exposure to the stimuli (Frid and Dill, 2002). In that case, bird populations would need to be protected by some type of conservation such as setback buffer distances posted on signs. Sensitization to disturbance in birds is a poorly studied phenomenon and should never be discounted without supporting data. For an example of possible sensitization, loom rate is the rate at which a predator or human disturbance proxy for a predator increases in size as it approaches; for predators or proxies moving at the same speed, loom rate is higher for nearby predators or proxies than for distant ones. As multiple exposures to the stimuli at different distances occur, the bird should increase its flight initiation distance to stimuli with higher loom rates. The bird would associate the high rate with closeness of the predator, becoming sensitized rather than habituated. The bird learns to recognize this high-loom-rate cue to danger of close predator approach (Frid and Dill, 2002).

Energy cost in birds is highest for flight. Flight in response to disturbance results in increased energy requirements and feeding time, and increased flight time reduces the total time for other activities (Korschgen et al., 1985; Belanger and Bedard 1990; Ely et al., 1999; Ackerman et al., 2004). Fleeing from disturbance may affect feeding ecology and the effects of predation in complex ways; staying put may increase or decrease fitness. Outdoor recreation, especially nature appreciation and bird watching, is expanding into refuges and putting additional stresses on wild populations (Klein et al., 1995; Schummer and Eddleman, 2003).

Ecotourists (including bird watchers and wildlife photographers) and outdoor recreators are not likely to be aware of the negative impacts that their presence may have on wildlife (Carney and Sydeman, 1999). Ecotourists can introduce high levels of disturbance to nesting waterbirds. Ecotourists often closely approach birds, return to the same sites repeatedly, and visit sites year-round. The beneficial adaptation of flushing to avoid predators may balance with costly and nonbeneficial flushing caused by humans.

Predation risk and its proxy (response to human disturbance) can impact reproduction via decisions about parental investment (Frid and Dill, 2002). Once parents have considerably invested in their offspring, they may protect their investment by remaining on the nest for the rest of the breeding season after a severe disturbance, but they may abandon their nest site the following year (Steidl and Powell, 2006).

The ultimate impact on a bird flock of a sufficient disturbance by recreationists depends on the overall vigilance of birds within a flock, the size of an individual flock (because in response to a disturbance resembling a predator the entire flock will flush), and the rate at which each flock is flushed per unit time.

Hypotheses for the value of flocking to birds focus especially on predator avoidance and foraging enhancement, but the relative contribution of different ecological factors to the adaptations(s) of flocks remain unclear (Beauchamp, 2004). Evolution of flocking may have occurred in birds preferring high-density clumped prey such as fruits and seeds, whose high densities assuage competition for food by dense flocks (Beauchamp, 2002). Dispersed foods, such as many insects and vertebrates, have lower abundance within clumps and a more uniform distribution, which may be matched by uniformly distributed solitary foraging birds (Beauchamp, 2002). Conspecific attraction allows individuals to locate clumps for other birds, forming a foraging flock (Beauchamp, 2002). Conspecific attraction makes little sense for resources with low abundance within clumps. Human disturbance occurs because birds respond to humans as if they were predators. Individuals in flocks may have evolved under substantial predation risks, and flocking may dilute predation risk. However, foragers at the edge of a flock are often first in line during predator attacks and do not benefit from the same dilution of risk as neighbors in the center of the group (Beauchamp and Ruxton, 2008). Some birds may be constrained to maximize feeding time per bird, which then requires a trade off with available vigilance time against predation per bird (i.e., reducing protections from predators). Increased flock size may result in food dilution (reduction in food abundance) and may result in reduced vigilance time per bird based on group reliance for protection (Beauchamp, 2008). In a meta-analysis, increasing group size was important in increasing vigilance time per bird but explained generally less than 20 percent of the variation in vigilance time per bird (Beauchamp, 2008). The degree of vigilance at the flock level will dictate the frequency of unnecessary flushing by nonconsumptive recreation users, causing impacts on energy consumption (feeding) that, in a popular recreational area, may be far more costly than the necessary natural flushing by predators.

Maintenance and Use of Navigation Waterways

Adverse impacts of navigation canals that support many types of vessels have substantial impacts on wetlands. Initial impacts are locally substantial, but largely limited to where canals and channels pass through wetlands. Current channels would not change as a result of the proposed action. In addition, no new channels would be required. Periodic maintenance dredging is expected in existing OCS-related navigation channels through barrier passes and associated bars. The major use of navigation channels, and therefore the driving force behind canal maintenance (including dredging), is by non-OCS-related traffic. Insignificant adverse impacts upon wetlands from maintenance dredging are expected because the large majority of the material would be disposed upon existing disposal areas. Wetland loss would impact waterbirds dependent on wetland habitat for nesting and feeding, and any permanent loss could cause irreversible reductions in populations of vulnerable wetland waterbirds.

Collisions of Coastal and Marine Birds with Wind Turbines, Communication Towers, Lighted Structures, Windows, Power Lines, and Fences

Wide-scale, long-term, standardized, and systematic assessments of bird collisions are few (Manville, 2005; Drewitt and Langston, 2008). Data on the status of one-third of all North American bird populations is lacking (Manville, 2005). Even so, the most informative studies (to be analyzed here) are for the entire United States and not specific to the area of the northern Gulf of Mexico. The most important structural factors related to collision probability may be size and lighting (Drewitt and Langston, 2008). No hypotheses for the apparent attraction of birds, especially nocturnally migrating songbirds, to lights have been conclusively supported (Drewitt and Langston, 2008). Birds that stopped at lighted structures during inclement weather and migrated on when weather conditions improved. The location of structures along the flight path, especially for flocks of birds, influences collision mortality. Warning lights for aircraft on towers >200 ft (61 m) are mandatory in the United States (Drewitt and Langston, 2008). Such lights may attract birds, especially at night or under conditions of low visibility, and birds may fatally collide with the lights. Birds that avoid collision with windows may become exhausted as the birds flutter against them, falling to the ground where they may be vulnerable to starvation or predation (Drewitt and Langston, 2008). Overall mortality caused by collision with tall buildings may be considerable (Drewitt and Langston, 2008). Window strikes may be the greatest cause of anthropogenic mortality of birds in the United States, at least an order of magnitude greater than the combined impacts of strikes with wind turbines, communication towers, tall buildings, and power lines (excluding distribution lines to residences and businesses) (Drewitt and Langston, 2008). Collisions with power lines and supporting towers can occur during inclement weather and during periods of migration, often causing death or permanent injury to birds (Avery et al., 1980; Avian Power Line Interaction Committee, 1994). By 2000, the estimated annual death toll from collision with communication towers was at least 4-5 million birds (Drewitt and Langston, 2008). A current estimate is 40-50 million deaths (Manville, 2005). Combining collision mortality estimates for communication towers, power lines, and window strikes, at least several hundred million birds are killed annually (Drewitt and Langston, 2008). The number of birds annually killed by collision with windows is 100 million to 1 billion birds, or 0.5-5 percent of the estimated 20 billion birds in the United States (Drewitt and Langston, 2008). Population mortality greater than 0.5 percent may have a serious impact (Drewitt and Langston, 2008). Rapid proliferation of structures in developed countries and their future inevitability in developing countries may cause serious future population declines in birds (Drewitt and Langston, 2008).

Disease

In the U.S., the most commonly diagnosed bacterial bird diseases were avian cholera, chlamydiosis, and salmonellosis. The most commonly diagnosed viral diseases were duck plague, paramyxovirus, and West Nile virus, together causing almost all deaths due to infectious diseases; fungal and parasitical infections were relatively minor (Newman et al., 2007). Even the collection of mosquito abundance and prevalence data for West Nile virus study is costly, and now health departments are struggling to maintain budgets for these procedures (Kilpatrick et al., 2007). Captive-reared whooping cranes have been vaccinated with a DNA vaccine for the RNA West Nile virus, which offers temporary relief but interferes with the natural selection for immune resistance (Kilpatrick et al., 2007).

Chemical pollution, the most commonly reported cause of death in scientific publications and the most important OCS-related impact (from oil spills), is probably less significant than infectious diseases in aquatic birds based on broad trends in aquatic bird mortality (Newman et al., 2007). A study much more narrow in scope notes that the impact of influenza viruses on wild animal host survival, reproduction, and behavior are almost completely unknown (Vandegrift et al., 2010). The two most important groups of migratory birds that are natural reservoirs for influenza viruses are waterfowl and charadriiformes (including shorebirds and gulls) (Vandegrift et al., 2010). LaDeau et al. (2007) stated that "Emerging infectious diseases present a formidable challenge to the conservation of native species in the twenty-first century." The number of diagnosed bird deaths was greater for viruses than for bacterial infections, and algal blooms had a relatively minor effect (Newman et al., 2007). The Newman et al. study was done before the DWH event and represents a far greater time span (1971-2005), divided into 5-year intervals as part of the analysis. A USGS database for the entire United States was used for analysis. Single oil spills such as the DWH event cannot be compared with results of Newman et al. (2007) because the latter is on a different, much broader time and spatial scale.

Storms and Floods

Coastal storms and hurricanes can often cause deaths to coastal birds through collisions because of high winds; associated flooding destroys active nests. Nesting territories and colonial bird rookeries with optimum food and/building materials may also be lost. Elevated levels of municipal, industrial, and agricultural pollutants because of storms and hurricanes in coastal wetlands and waters expose resident birds to chronic physiological stress. Storms and hurricanes are part of the natural environment (specifically, climate) of all ecosystems of the Gulf of Mexico, and any adaptations to them will have occurred through natural selection of surviving and reproducing organisms over millions of years.

Coastal Development

The construction of buildings and other facilities is expected to continue to encroach on bird habitat in the northern Gulf of Mexico. Areal extent of the proportion of habitat lost may increase linearly with ecological consequences to birds. However, new research indicates that habitat loss may sometimes have a critical threshold above which it increases nonlinearly and with greater degree (higher slope) with increasing ecological consequences (Swift and Hannon, 2010). This conclusion is based on simulations and empirical studies. The presence of thresholds depends on the characteristics of species and landscapes. Most existing studies of thresholds have not used any formal statistical methods to identify their presence or value (Swift and Hannon, 2010). Any loss of habitat from facility construction will be permanent, causing possible permanent reductions in population density of some species of birds. Urban and suburban expansion will exclude the large variety of wild birds from their habitat, because urban and suburban conditions do not generally support such a variety. Adequate habitat for wild birds has greatly declined as human development continues to require more and more land, outside of the parks and other areas set aside for bird conservation.

Fisheries Interactions

Commercial fisheries may accidentally entangle and drown or injure birds during fishing operations or by lost and discarded fishing gear. Seabird bycatch before regulation caused severe global declines in many seabird species. The longline fisheries in the Gulf of Mexico comprise pelagic tuna and swordfish, bottom shark, and bottom reef. The total incidental seabird bycatch for the bottom longline fisheries was one gull of unidentified species, two brown pelicans, one herring gull, and two unidentified seabirds from 2005 to 2008; for the pelagic fishery, it was one brown pelican and two unidentified seabirds from 1992 to 2005 (Hale and Carlson, 2007; Hale et al., 2007; Scott-Denton, official communication, 2009; Hale et al., 2009; Beerkircher, official communication, 2009). With recent volunteer monitoring or mandatory observation, cumulative impacts for future bird bycatch of longline fisheries on marine birds in the northern Gulf of Mexico are expected to be negligible. Competition for prey species may occur between birds and fisheries. Fisheries catch may reduce population densities of avian aquatic predators limited by food availability by taking substantial food away (reducing the abundance of the prey base). Commercial, and to a lesser extent recreational, fisheries introduce a pressing concern over competition for fish that also serve as food for many birds. Given that the commercial fisheries in the GOM are a relatively recent phenomenon and that the pressures on commercially sought fish are increasing, birds continue to be impacted by this competition and have not been able to adapt as yet. Birds would adapt by becoming more efficient in their exploitation of food resources so they could survive and reproduce successfully with a prey base of lower abundance. Increased food resources from discarded fishery bycatch may have the opposite (positive) impact.

Summary and Conclusion

Activities considered under the cumulative activities scenario will detrimentally affect coastal and marine birds. It is expected that the majority of effects from the major impact-producing factors on coastal and marine birds are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) and would usually cause temporary disturbances and displacement of localized groups inshore because the activities themselves are temporary based on the net effect of habitat loss from oil spills, new construction, and maintenance and use of pipeline corridors and navigation waterways will alter species composition and reduce the overall carrying capacity of disturbed area in general.

The cumulative effect on coastal and marine birds from all sources is expected to result in a discernible decline in the numbers of birds that form localized groups or populations, with associated change in species composition and distribution. Some of these changes are expected to be permanent and to stem from a net decrease in preferred habitat for all birds and in critical habitat for endangered species. However, the incremental contribution of the proposed action to the cumulative impact is negligible because the effects of the most probable impacts, such as sale-related operational discharges and helicopters and service-vessel noise and traffic, are estimated to be sublethal and some displacement of local individuals or groups may occur. Proposed action activities considered under the cumulative scenario may detrimentally affect coastal and marine birds. The net effect of habitat loss from oil spills, OCS pipeline landfalls, and maintenance and use of navigation waterways, as well as habitat loss and modification resulting from coastal facility construction and development, will alter species composition and reduce the overall carrying capacity of disturbed area(s) in general. These would be the most serious cumulative impacts from proposed action activities on birds. However, the impacts from these activities with the WPA proposed action would be minimal compared with non-OCS-related activities. This is in part because an oil spill would affect a small portion of a bird group, because there would be a low number of pipeline landfalls, and because of the regulations, technologies, and mitigation requirements in place for dredging and construction activities. Impacts of an oil spill on whooping crane or piping plover would be more substantial than for the impact of other species, which would have large unaffected populations that could serve as sources for recolonizing areas where lethal impacts of oil occur. Piping plover has the advantage that, even if spill-related mortality occurs, the amount of suitable unscathed habitat in the GOM would likely be substantial (on a scale similar to much more abundant species). Factors that have reduced piping plover population abundance occurred only on the breeding grounds, well to the north of the Gulf of Mexico. It is expected that the majority of effects from the major impact-producing factors on coastal and marine birds are sublethal (i.e., behavioral effects from aircraft and vessel traffic and noise and bird-watching activities; and nonfatal exposure to or intake of trash, debris, and OCS-related contaminants from air emissions and degradation of water quality). Unregulated recreational activities may seriously stress birds because approach to birds by humans has uncertain consequences and because recreationists usually do not realize the sublethal consequences of intrusion.

Nocturnal circulation events at platforms are expected to have minimal and mostly sublethal impacts on migrating bird populations. This conclusion results from the confirmed low mortality from the starvation for all birds that landed on the platforms that were examined by Russell (2005) and from the suggested sublethal stress in birds that dropped out of circulation. Behavioral impacts will usually cause temporary disturbances and displacement of inshore flocks. Collisions of coastal and marine birds with structures such as power line towers are usually lethal. Disease is often lethal but it may be a part of natural avian population control unless the pathogen is introduced by humans, such as for the West Nile virus. Storms and floods are natural disturbances to which exposed organisms are generally adapted, except for hurricane storm surge, which is exacerbated by coastal wetland loss in Louisiana.

The effect of the WPA proposed action to the cumulative effect of programmatic activities on coastal and marine birds is expected to result in a small but discernible decline in the numbers of birds, with associated change in species composition and distribution. Some of these changes are expected to be permanent and to stem from either a net decrease in preferred food resources or displacement of food resources and/or a decrease in the availability of preferred or critical habitat.

The DWH event and resulting oil spill in Mississippi Canyon Block 252 and the related spill-response activities may impact birds that come into contact with oil and remediation efforts. The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on the affected coastal and marine bird environment; therefore, this analysis is based on credible scientific information available since the Macondo spill, and applied using accepted methodologies. Some bird populations in the CPA were almost certainly affected over at least the short term by the DWH event. Except for seabirds, such birds likely have not migrated and will not migrate into the WPA, where they would be exposed to an increment of the cumulative impacts caused by the WPA proposed action.

The BOEMRE has considered this assessment and has reexamined the cumulative analysis for birds presented in the Multisale EIS, the 2009-2012 Supplemental EIS, and the cited new information. Based on this evaluation, conclusions in these analyses on effects to birds remain unchanged in regards to Routine Activities (no potential for significant adverse effects) and Accidental Spills (no potential for significant adverse effects).

Unavailable information on effects to seabirds from the DWH event (and thus changes to the seabird baseline in the Affected Environment) makes an understanding of the cumulative effects less clear; although as noted above in the description of the Affected Environment, most species in the WPA were likely unaffected based on residency periods and migration patterns. Here, BOEMRE concludes that the unavailable information from this event may be relevant to foreseeable significant adverse impacts to seabirds. Relevant data on the status of seabird populations after the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeline contemplated in this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEMRE subject-matter experts have used available scientifically credible evidence in this analysis and based upon accepted methods and approaches.

Nevertheless, a complete understanding of the missing information is not essential to a reasoned choice among alternatives for this Supplemental EIS (including the No Action and Action Alternatives) for the following reason. There are 1,394 active leases in the WPA with ongoing (or the potential for) exploration, drilling, and production activities (USDOI, BOEMRE, 2011). In addition, non-OCS energy-related activities will continue to occur in the WPA irrespective of this proposed lease sale (i.e., fishing, military activities, and scientific research). The potential for effects from changes to the Affected

Environment (post-DWH), Routine Activities, Accidental Spills (including low-probability catastrophic spills), and Cumulative Effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on birds from either smaller accidental events or low-probability catastrophic events will remain the same.

Within the WPA, there is a long-standing and well-developed OCS program. There are no data to suggest that activities from the pre-existing OCS program are significantly impacting seabird populations. Therefore, in light of the above analysis on the proposed action and its impacts, the incremental effect of the proposed action on seabird populations is not expected to be significant when compared with non-OCS energy-related activities.

4.1.1.13. Fish Resources and Essential Fish Habitat

The BOEMRE has reexamined the analysis for fish resources and essential fish habitat (EFH) presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusions for fish resources and EFH presented in the Multisale EIS and the 2009-2012 Supplemental EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in Chapter 4.5.10 of the Multisale EIS. A summary of those analyses and their reexamination due to new information is presented in the following sections. A brief summary of potential impacts follows. Fish resources and EFH could be impacted by coastal environmental degradation, marine environmental degradation, pipeline trenching, and offshore discharges of drilling discharges and produced waters associated with routine activities. The impact of coastal and marine environmental related to the proposed action degradation is expected to cause an undetectable decrease in fish resources or EFH. Impacts of routine discharges are localized in time and space, are regulated by USEPA permits, and would have minimal impact. Accidental events that could impact fish resources and EFH include blowouts and oil or chemical spills. A subsurface gas blowout would have a negligible effect on Gulf of Mexico fish resources because it would cause only localized sediment disturbance but no release of oil. If a subsurface oil blowout or spill due to the WPA proposed action were to occur in open waters of the OCS proximate to mobile adult finfish or shellfish, the effects would likely be nonfatal and the extent of damage would be reduced due to the capability of adult fish and shellfish to avoid a spill.

Impact-producing factors of the cumulative scenario that are expected to substantially affect fish resources and EFH include coastal and marine environmental degradation, overfishing, and to a lesser degree, coastal petroleum spills and coastal pipeline trenching. At the estimated level of cumulative impact, the resultant influence of the proposed action on fish resources and EFH is not expected to be easily distinguished from effects due to natural population variations. The incremental contribution of the WPA proposed action to the cumulative impacts on fisheries and EFH would be small.

4.1.1.13.1. Description of the Affected Environment

A detailed description of fish resources and EFH can be found in Chapter 3.2.8 of the Multisale EIS. Any new information since the publication of the Multisale EIS is presented in Chapter 4.1.11 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The Gulf of Mexico supports a great diversity of fish. Distributions of fish species are dependent on a variety ecological factors that include salinity, primary productivity, and bottom type. These factors differ widely across the Gulf of Mexico and between the inshore and offshore waters. Characteristic fish resources are associated with the various environments and are not randomly distributed. Major gradients include rainfall and river output, bottom composition, and depth. High densities of fish resources are associated with particular habitat types. Most finfish resources are linked both directly and indirectly to the vast estuaries that ring the Gulf of Mexico. Estuaries serve as nursery grounds for a large number of marine fishes that live on the inner continental shelves, such as the anchovies, herrings, mojarras, and drums. Because of the variety of habitats, almost the entire GOM is within a designated EFH. The EFH regulations (50 CFR 600) require NMFS to describe and identify habitats determined to be EFH for each life stage of each managed species.

The Gulf also has some limited areas of hard substrate on the continental shelf, including topographic features or banks offshore Texas and Louisiana in the WPA. The remaining OCS shelf, ranging to a depth of approximately 200 m (656 ft), generally has a muddy or silty soft bottom. Fish communities that occur on topographic features and pinnacles are described in Chapter 3.2.8.1 of the Multisale EIS. Deepwater, demersal fishes occurring below several hundred meters are better known than the deep pelagic species. Extensive trawl sampling of the Gulf of Mexico continental slope demersal fish are reported in a major Agency-funded, deep Gulf study (Gallaway, 1981).

Recently, hurricanes have been a prominent impacting factor to Gulf resources and have affected fish resources by destroying oyster reefs and by changing physical characteristics of inshore and offshore ecosystems. The intense hurricane season of 2005, including Hurricanes Katrina and Rita, did not affect the offshore fisheries as much as initially expected. By far, the worst resource devastation that occurred was for oyster populations, but even this fishery has recovered significantly as evidenced in the Louisiana Dept. of Wildlife and Fisheries' Stock Assessment Report for the public oyster seed grounds (Louisiana Dept. of Wildlife and Fisheries, 2010).

In September, 2008, the Louisiana Dept. of Wildlife and Fisheries (2008a and 2008b) released preliminary nonquantitative reports of the effects of Hurricanes Gustav and Ike on Louisiana fisheries. In it they noted the extensive marsh erosion and vegetative debris present in the canals of southeastern Louisiana, as well as localized fish kills, loss of marsh through erosion, and displacement and encroachment of saltwater into freshwater areas, a contributor to loss of essential fish habitat.

The DWH event in Mississippi Canyon Block 252, southeast of Venice, Louisiana, introduced large quantities of oil into the water column between the spill site and the marshes of the central Gulf Coast during the spring and summer of 2010. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). Oil from this incident has been observed to contact shorelines from east of the Texas/Louisiana border to Apalachicola, Florida, with the primary areas of oiling occurring from Grand Isle, Louisiana, west of the mouth of the Mississippi River to Pensacola, Florida (USDOC, NOAA, 2010d). The oil penetrated estuaries at least along the Louisiana and Mississippi coasts and has been driven farther inshore by the passage of Hurricane Alex, which made landfall near the Texas/Mexico border. All of these estuaries are extremely important nursery areas (EFH) for fish and aquatic life (Bahr et al., 1982). Oiling of these areas, depending on the severity, can destroy nutrient-rich marshes and erode coastlines, adding to the destruction caused by the recent hurricanes. Although these estuaries are beyond the boundaries of the WPA, due to the mobile nature of fish stocks, larvae and juveniles, some of the fish in the WPA may have originated in or migrated through areas affected by the DWH event.

The addition of *Corexit 9500* at the seafloor spill site and the surface resulted in the dispersion of oil in the water column. Although *Corexit 9500* is believed to be the least toxic of all of its counterparts to small fish, its toxicity mixed with oil to specific species of ichthyoplankton is unknown. The USEPA and NOAA have proposed a monitoring program that will assess the toxicity of 20:1 oil/*Corexit* to Atlantic silversides. Although information from the monitoring program and specific impacts of dispersants to fish in the WPA is currently unknown, this information would not be essential to a reasoned choice among alternatives because, among other things, the fish impacted by dispersants in the WPA, if any, are likely to be greatly outnumbered by fish that were not in the CPA at the time of dispersant use, avoided the areas impacted east of the WPA, and the fact that there has been no documented fish kills in the WPA since the DWH event.

How assemblages of fish in the WPA have changed as a result of the DWH event is unknown at this time and studies are ongoing. Based on existing research, adult fish, however, tend to avoid contact with oil in the water column. In general, most reef fishes are associated with habitats on the continental shelf inshore of the spill, and these would be more likely to have occurred in the CPA. Most of these fish in the CPA spawn during spring/summer and the larvae may be at risk from the spill, affecting recruitment in future age classes. Surface feeders such as menhaden and inhabitants of seagrass beds in the CPA may be at risk, depending on whether the oil floats or sinks. Sharks are commonly found Gulfwide in nearshore and offshore waters. Blacktip sharks and bull sharks are often found in estuaries Gulfwide and those in the CPA may be at risk, along with other estuarine species depending on the extent of the penetration of the oil into the estuaries. Although information on how assemblages of fish in the WPA have changed as a result of the DWH event is not available, this information is not essential to a reasoned choice among the alternatives because, among other things, adult fish tend to avoid adverse conditions and, thus, any expected number of fish impacted by the DWH event and oil spill that are now in the WPA would be relatively small.

Of particular concern are Gulf populations of bluefin tuna because their populations may have declined in the past decades due to overexploitation unrelated to OCS activities. Although bluefin tuna are highly migratory, their spawning and breeding grounds in the GOM are concentrated in the CPA. The occurrence of bluefin tuna larvae associated with the Loop Current boundary and the Mississippi River discharge plume is evidence that these species spawn in the GOM (Richards, 1990). Block et al. (2001) also reported on the GOM being used as a breeding ground and demonstrated trans-Atlantic migrations of bluefin tuna between the eastern Mediterranean, Atlantic, and GOM using electronic data storage tags. The North Atlantic bluefin tuna has its peak spawning period in April and May in the Gulf.

The western Atlantic stock has suffered a significant decline in spawning stock biomass since 1950 because of overexploitation, and a 20-year rebuilding plan has failed to revive the population or the North American fishery. The failure of the GOM spawning population to rebuild, as well as the scope of illegal and under-reported catches, particularly in the Mediterranean Sea, are of such major concern that the species was recently considered by the Convention for International Trade in Endangered Species for endangered species listing in March 2010. More recently, as a result of a petition by the Center for Biological Diversity,, The NMFS also considered listing Atlantic bluefin tuna as endangered or threatened under the ESA. On May 27, 2011, after extensive review, NOAA announced that the bluefin tuna did not warrant species protection under the ESA. The NOAA has, however, committed to review this decision in early 2013 based on a Stock Assessment to be completed in 2012 and pending more information on the DWH event (*Federal Register*, 2011).

Because of their decline in stock, the timing of their spawn in the Gulf, their buoyant eggs, and the timing of the DWH event, there is concern about further decline in the Gulf stock of bluefin tuna. The effects at this time are, however, unknown. It is unlikely that this information will be available within the timeframe contemplated for this Supplemental EIS, even if the resources were available to undertake these studies, due to the highly migratory nature of this species (making study difficult), the difficulty in segregating various causes of decline in the stocks already (such as overexploitation), and the inability to distinguish natural population variabilities due to other naturally occurring environmental factors. In the impacts analysis below, then, credible scientific information that is available on impacts to the species has been applied using accepted methodologies. In any event, although this information is currently unavailable, it is not essential to a reasoned choice among alternatives because the impacts to the individuals that happened to be in the CPA at the time of the spill and that may have been affected would likely be spread among the entire range of the species, of which the WPA is only a small part, and that any impacts that did occur do not rise to population-level effects.

Thus far, only anecdotal (observational) evidence is available concerning fish kills. Offshore, a few small fish kills very near the Macondo well have been reported to date. None have been reported in the WPA.

Essential Fish Habitat

In consideration of existing mitigation measures, lease stipulations, and a submitted EFH assessment document, this Agency entered into a Programmatic Consultation agreement with NMFS on July 1, 1999, for petroleum development activities in the WPA.

Chapters 1.5 and 2.2.2 of the Multisale EIS discuss this Agency's approach to the preservation of EFH with specific mitigations. Chapter 3.2.1 of the Multisale EIS details coastal areas that are considered EFH, including wetlands and areas of submerged vegetation. A more detailed description of the EFH program in the Gulf of Mexico is in Chapter 3.2.8.2 of the Multisale EIS.

In 2005, a new amendment to the original EFH Generic Amendment was finalized (GMFMC, 2005). One of the most significant proposed changes in this amendment reduced the extent of EFH relative to the 1998 Generic Amendment by removing the EFH description and identification from waters between 100 fathoms and the seaward limit of the EEZ. There are Fishery Management Plans in the Gulf of Mexico OCS region for shrimp, red drum, reef fishes, coastal migratory pelagics, stone crabs, spiny lobsters, coral and coral reefs, billfish, and highly migratory species. The Highly Migratory Species Fisheries Management Plan was recently amended to update EFH and habitat areas of particular concern for the bluefin tuna spawning area (USDOC, NOAA, 2009). There are current NTL's (NTL 2009-G39 and NTL 2009-G40) that provide guidance and clarification of the regulations with respect to biologically sensitive underwater features and areas and benthic communities, which are considered EFH (USDOI, MMS, 2009b and 2009c).

The EFH is defined as the waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. The Gulf of Mexico waters out to 100 fathoms have EFH described and identified for managed species. These EFH's are discussed in various sections of the Multisale EIS, 2009-2012 Supplemental EIS and this Supplemental EIS: the water column (Chapter 3.1.2 of the Multisale EIS and **Chapter 4.1.1.2.1** of this Supplemental EIS); wetlands (Chapter 3.2.1 of the Multisale EIS and **Chapter 4.1.1.4.1** of this Supplemental EIS); submerged vegetation (Chapter 3.2.1 of the Multisale EIS and **Chapter 4.1.1.5.1** of this Supplemental EIS); topographic features (Chapter 3.2.2 of the Multisale EIS and **Chapter 4.1.1.6.1** of this Supplemental EIS); *Sargassum* (**Chapter 4.1.1.7.1** of this Supplemental EIS); chemosynthetic and nonchemosynthetic communities (Chapter 3.2.2 of the Multisale EIS and **Chapters 4.1.1.8.1 and 4.1.1.9.1** of this Supplemental EIS); and soft bottoms (**Chapter 4.1.1.19.1** of this Supplemental EIS).

4.1.1.13.2. Impacts of Routine Events

Background/Introduction

A detailed description of fish resources and EFH can be found in Chapter 3.2.8 of the Multisale EIS. A detailed description of the possible impacts from routine activities associated with the WPA proposed action on fish resources and EFH is presented in Chapter 4.2.1.1.8 of the Multisale EIS and Chapter 4.1.11.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the Supplemental EIS, and new information that has become available since both documents were prepared.

Effects on fish resources and EFH from routine activities associated with the proposed action could result from coastal environmental degradation, marine environmental degradation, pipeline trenching, and offshore discharges of drilling discharges and produced waters. Since the majority of fish species within the WPA are estuary dependent, coastal environmental degradation resulting from the proposed action, although indirect, has the potential to adversely affect EFH and fish resources. The environmental deterioration and effects on EFH and fish resources result from the loss of Gulf wetlands and coastal estuaries as nursery habitat and from the functional impairment of existing habitat through decreased water quality.

Proposed Action Analysis

The routine impact effects of the WPA proposed action on coastal wetlands and coastal water quality, with the exception of accidental events, are analyzed in detail in Chapters 4.2.1.1.3.2 and 4.2.1.1.2.1 of the Multisale EIS, respectively. Collectively, the adverse impacts from these effects are called coastal environmental degradation in this Supplemental EIS. The effects of the WPA proposed action on offshore live bottoms and marine water quality are analyzed in detail in Chapters 4.2.1.1.4.1.1 and 4.2.1.1.2.2 of the Multisale EIS, respectively. Collectively, the adverse impacts from these effects are called marine environmental degradation in this Supplemental EIS. The direct and/or indirect effects from coastal and marine environmental degradation on fish resources and EFH are summarized and considered below.

Coastal Environmental Degradation

A range of 0-1 new pipeline landfalls are projected in support of the proposed action (Chapter 4.1.1.8.1 of the Multisale EIS). Localized, minor degradation of coastal water quality is expected in waterbodies in the immediate vicinity of coastal shore bases, commercial waste-disposal facilities, and oil refineries or gas processing plants as a result of routine effluent discharges and runoff. There are two new gas processing plants projected in Texas to support the WPA proposed action (Table 4-9 and Chapter 4.1.2.1.4.2 of the Multisale EIS).

Chapters 4.2.1.1.3.2 and 4.2.1.1.3.3 of the Multisale EIS and **Chapters 4.1.1.4.2 and 4.1.1.5.2** of this Supplemental EIS consider the effects from the proposed action on wetlands and submerged vegetation. A small amount of the routine dredging done in coastal areas could be a direct or indirect consequence of the proposed action. Some resuspension of bottom contaminants would be realized during dredging operations, although very little would be soluble in the water column and in bioavailable form. Since the proposed action would have minimal impact to the coastal environment, it is expected that coastal environmental degradation from the proposed action would have little effect on fish resources or EFH. Due to the resuspension of bottom sediments associated with dredging, fish would likely avoid the area during the event and would temporarily relocate to another area; these fish typically return to the area once the event has ceased, and EFH was only temporarily affected but not lost. Recovery of fish resources or EFH can occur from most, but not all, of the potential coastal environmental degradation. Most fish populations, if left undisturbed, would regenerate quickly because impacts to the habitat would generally be temporary; fish tend to avoid areas of impact (thus reducing mortality effects) and they are prolific reproducers. The loss of wetlands as EFH could be permanent, although this is less of a concern in Texas. In the case of wetlands that may be permanently lost, for example, this would likely be converted to another form of EFH, such as conversion to open water or submerged aquatic habitat., At this expected low level of effect, the resultant influence on fish resources or EFH from the WPA proposed action would be negligible and indistinguishable from natural population variations.

Marine Environmental Degradation

The proposed action could potentially impact the marine environment through activities such as discharges, bottom disturbance, and structure removal. For any activities associated with the proposed action, USEPA's Region 6 would regulate discharge requirements for the WPA through their NPDES permits. The projected total number of production structure installations resulting from the WPA proposed action (26-41) is for all water depths (**Table 3-2**). Bottom disturbance from structure emplacement operations associated with the proposed action would produce localized, temporary increases in suspended sediment loading, resulting in decreased water clarity and little reintroduction of pollutants. Structure removal results in artificial habitat loss and causes fish kills when explosives are used.

Most multi-leg platforms are removed by severing their pilings with explosives placed 4.6 m (15 ft) below the seafloor. It is projected that 9-18 structures in water depths <200 m (<656 ft) in the WPA would be removed using explosives as a result of the proposed action (**Table 3-2**). It is expected that structure removals would have a negligible effect on fish resources because these activities kill only those susceptible fish in close proximity to the removal site would be limited in geographic scope and therefore not rise to any population-level impacts across the WPA or Gulf of Mexico generally.

The projected length of offshore pipeline installations for the WPA proposed action is 130-760 km (81-472 mi) for all water depths (**Table 3-2**). Trenching for pipeline burial has the potential to adversely affect fish resources by disturbing the shelf bottom and by increasing turbidity in close proximity to the pipeline activity. Any affected population is expected to avoid areas of excessive turbidity because the population's typical behavior is to avoid any adverse conditions in water quality. At the expected low level of impact, the resultant influence of the proposed action on fish resources would be negligible and indistinguishable from other natural population variations.

The major sources of routine discharges to marine waters associated with the WPA proposed action are the temporary discharge of drilling muds and cuttings and the long-term discharge of produced-water effluent. Drilling muds can contain materials such as mercury and cadmium, which may be toxic to fishery resources depending on their concentration; however, the discharge plume of these muds disperses rapidly. Therefore, concentrations are near background levels at a distance of 1,000 m (3,281 ft) and are usually nondetectable at distances greater than 3,000 m (9,842 ft) (Kennicutt, 1995).

The toxicity of the metals associated with drilling muds also depends upon their bioavailability to organisms. Methylmercury is the bioavailable form of mercury (Trefry and Smith, 2003), In a study of methylmercury in sediments surrounding six offshore drilling sites, it was found that methylmercury concentrations did not vary significantly between near-field and far-field sites (Trefry et al., 2003). Therefore, it appears that methylmercury concentrations near OCS activities are not significantly different from background levels in the Gulf of Mexico. Further, the study suggested that levels of methylmercury in sediments around drilling sites are not a widespread phenomenon in the Gulf of Mexico (Trefry et al., 2003). The discharge of drilling muds is, therefore, not anticipated to contribute to fish mortality either through direct exposure to discharged drilling muds or resuspension of muds through wave action or dredging.

Produced-water discharges contain components and properties potentially detrimental to fish resources, including trace metals, hydrocarbons, brine, and organic acids. Offshore discharges of produced water are expected to disperse and dilute to background levels within 1,000 m (3,280 ft) of the discharge point (CSA, 1997). Produced water has not been shown to cause fish mortality in populations surrounding platforms. Produced water dilutes rapidly after discharge and is usually discharged near the surface so that the dilution factor is maximized. In addition, the discharge of produced water is regulated by U.S. Environmental Protection Agency NPDES permits.

It is expected that marine environmental degradation from the WPA proposed action would have little effect on fish resources or EFH. The primary factors that affect fish populations as a result of the drilling operations discussed above have relatively minor impacts to fish resources. Fish resources are also highly variable and are distributed over a very large area in the Gulf of Mexico. It is often impossible to separate the natural population variability from any potential impact due to marine environmental degradation and decrease in fish populations in the Gulf of Mexico. Recovery of fish resources or EFH can generally occur from the potential marine environmental degradation. Most fish populations, if left undisturbed, regenerate quickly because impacts to the habitat would generally be temporary; fish tend to avoid areas of impact (thus reducing mortality effects) and they are prolific reproducers. Offshore live bottoms and topographic features are not expected to be impacted (**Chapter 4.1.1.6**).

Offshore discharges are regulated by U.S. Environmental Protection Agency NPDES permits. At the expected low level of effect, the resultant influence on fish resources or EFH would be negligible and indistinguishable from natural population variations.

In addition, the Topographic Features Stipulation (discussed in Chapters 2.2.2 and 2.3.1.3.1 of the Multisale EIS, Chapter 2.2.1.3 of the 2009-2012 Supplemental EIS, and **Chapter 2.3.1.3.1** of this Supplemental EIS) may be applied to the proposed action. The application of the guidelines outlined in NTL 2009-G39, “Potentially Sensitive Biological Features,” would also serve to prevent impacts to hard-bottom EFH habitat associated with topographic features that may be outside previously defined No Activity Zones. The lease stipulation and NTL 2009-G39 protect sensitive EFH from both routine and accidental impacts that may occur during petroleum production. This stipulation and NTL, among other things, focus OCS activities at specified distances from the topographic features, a sensitive EFH, thereby increasing the distance between the features and their associated fish populations.

Other Factors

Structure emplacements can act as fish attracting devices and can result in aggregation of highly migratory fish species. A number of commercially important highly migratory species, such as tunas and marlins, are known to congregate around fish attracting devices. The attraction of pelagic highly migratory species to offshore structures would likely occur to some degree. Almost immediately after a platform is installed, the structure would be acting as an artificial reef. After just a few years, many of the fish species present would be residents and not new transients. Reef-building corals and other species such as black corals have also been documented colonizing numerous platforms (Sammarco et al., 2004; Boland and Sammarco, 2005).

Summary and Conclusion

The BOEMRE has reexamined the analysis for impacts to fish resources and EFH presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented above. No substantial new information was found that would alter the overall conclusion that impacts to fish resources and EFH from routine activities associated with the WPA proposed action would be minimal. Because of the mitigations described in the above analysis, the WPA proposed action is expected to result in a minimal decrease in fish resources and/or standing stocks or in EFH. It would require a short time for fish resources to recover from most of the impacts because impacts to the habitat would generally be temporary; fish tend to avoid areas of impact (thus reducing mortality effects) and most fish species are prolific reproducers.. Recovery from the loss of wetlands habitat would probably not occur, but it would likely result in conversion of the lost wetland habitats into open water or mudflats, which may qualify as other forms of EFH.

It is expected that any possible coastal and marine environmental degradation from the WPA proposed action would have little effect on fish resources or EFH. The impact of coastal and marine environmental degradation is expected to cause a nondetectable decrease in fish resources or in EFH. Routine activities such as pipeline trenching and OCS discharge of drilling muds and produced water would cause negligible impacts that would not deleteriously affect fish resources or EFH. This is because of regulations, mitigations, and practices that reduce the undesirable effects on coastal habitats from dredging and other construction activities. Permit requirements should ensure that pipeline routes either avoid different coastal habitat types or that certain techniques are used to decrease impacts. At the expected level of impact, the resultant influence on fish resources would cause minimal changes in fish populations or EFH. That is, if there are impacts, they would be short term and localized; therefore, they would only affect small portions of fish populations and selected areas of EFH. As a result, there would be little disturbance to fish resources or EFH. In deepwater areas, many of the EFH's are protected under stipulations and regulations currently set in place.

Additional hard-substrate habitat provided by structure installation in areas where natural hard bottom is rare would tend to increase fish populations. The removal of these structures would eliminate that habitat, except when decommissioned platforms are used as artificial reef material. This practice is expected to increase over time.

4.1.1.13.3. Impacts of Accidental Events

Background/Introduction

A detailed description of accidental impacts upon fish resources and EFH in the WPA can be found in Chapter 4.4.10 of the Multisale EIS and in Chapter 4.1.11.3 of the 2009-2012 Supplemental EIS. The risk of oil spills from the proposed action has the potential to affect fish resources and EFH, and it is discussed in detail in Chapter 4.3.1 of the Multisale EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Further, the effect of accidental events from the WPA proposed action on coastal wetlands and coastal water quality is analyzed in Chapters 4.4.3.2 and 4.4.2.1 of the Multisale EIS and in Chapters 4.1.3.2.3 and 4.1.2.1.3 of the 2009-2012 Supplemental EIS. These previous documents are mentioned because they provide important background information on fisheries species. Accidental events that could impact fish resources and EFH include blowouts and oil or chemical spills.

Proposed Action Analysis

Currently, the WPA proposed action is estimated to result in the drilling of a total of 40-66 exploration wells and 137-221 development and production wells. Of these production wells, 39-65 are estimated to be producing oil wells and 83-127 are estimated to be producing gas wells (**Table 3-2**). There is a 31-46 percent chance of one or more spills ≥1,000 bbl occurring. The most likely source or cause of an offshore spill is also discussed in Chapters 4.3.1.5.2 and 4.3.1.6.2 of the Multisale EIS. The most likely size of spill is the smallest size group (<1 bbl). Spills that contact coastal bays and estuaries would have the greatest potential to affect fish resources. The risks of an oil spill ≥1,000 bbl occurring and contacting county and parish shorelines and specific sensitive biological features were calculated and are presented in Figures 4-12, 4-13, 4-14, and 4-16 of the Multisale EIS. The probability of an oil spill ≥1,000 bbl occurring and passing over Stetson Bank is 2-4 percent and over the Flower Garden Banks is 4-7 percent over the 40-year life of the WPA proposed action. The biological resources of other hard/live bottoms in the Gulf of Mexico (EFH) would remain unharmed as spilled substances could, at the most, reach the seafloor in minute concentrations. This is because of the great distances and time required for transportation from the deepwater areas of the WPA proposed action.

There is a small risk of spills occurring during shore-based support activities, and the majority would be small in size because they would generally be limited to vessel and shore-based storage tanks with limited capacity. Most of these incidents would occur at or near pipeline terminals or shore bases and are expected to affect a highly localized area with low-level impacts. As a result of spill response and cleanup efforts, most of the inland spills would be recovered and what is not recovered would affect a small area and dissipate rapidly due to the smaller size of these spills generally, volatilization, and quicker response times for cleanup activities. A total of 15-34 coastal spills of all sizes are estimated to occur over the 40-year life of the WPA proposed action (Chapter 4.3.1.7.1 of the Multisale EIS). It is also assumed that a petroleum spill would occasionally contact and affect nearshore and coastal areas important to GOM fisheries. These species are highly migratory and would, based on typical observed behavior, actively avoid the spill area.

Blowout and Oil-Spill Impacts

Loss of well control and resultant blowouts seldom occur on the Gulf OCS. The potential causes and probabilities of blowouts are discussed in Chapter 4.3.2 of the Multisale EIS. A blowout with hydrocarbon release has a low probability of occurring as a result of the proposed action. Less than one blowout of ≥1,000 bbl is projected for the entire depth range of the WPA proposed action. A blowout with oil release is not probable to occur, but it is possible given the occurrence of the DWH event.

Subsurface blowouts, although highly unlikely, have the potential to adversely affect fish resources. A blowout at the seafloor could create a crater and resuspend and disperse large quantities of bottom sediments. This potentially affects a limited number of resident and transient fish in the immediate area. The majority of mobile deep-sea benthic or near-bottom fish taxa would be expected to leave (and not re-enter) the area of a blowout before being impacted by the localized area of resuspended sediments.

Resuspended sediments can clog fish gills and interfere with respiration for those fish that happen to be in the area at the time of the blowout. Settlement of resuspended sediments may directly smother deepwater invertebrates that serve as food sources. However, coarse sediment should be redeposited quickly within several hundred feet or meters of a blowout site. Finer sediments can be more widely dispersed and redeposited over a period of hours to days within a few thousand meters or feet depending on the particle size. Other fish not in the immediate area at the time of the blowout would be expected to avoid the impacted area, based on their typical observed behavior to avoid adverse conditions.

Oil loss from a blowout is possible; however, less than 10 percent of blowouts in recent history have resulted in spilled oil. Gas blowouts consist mainly of methane, which rapidly dissolves in the water column or disperses upward into the air. These gas blowouts are less of an environmental risk. Loss of gas well control does not always release liquid hydrocarbons. The release of hydrocarbons with the gas is possible.

Early life stages of animals are usually more sensitive to environmental stress than adults (Moore and Dwyer, 1974). Oil can be lethal to fish, especially in larval and egg stages, depending on the time of the year that the event happened. Weathered crude oil has been shown in laboratory experiments to cause malformation, genetic damage, and even mortality at low levels in fish embryos of Pacific herring (Carls et al., 1998). Hernandez et al. (2010) recently studied seasonality in ichthyoplankton abundance and assemblage composition in the northern GOM off of Alabama. They found larvae representing 58 different families. Fish egg abundance, total larval abundance, and taxonomic diversity were significantly related to water temperature, not salinity, with peaks in spring, spring-summer, and summer. Detailed analyses of ichthyoplankton are not available east and west (closer to the spill) of the sampling station. The patterns found in this study do indicate, however, that a possible mortality occurred in the larval fishes of the Gulf that came in contact with the spilled oil. This depends on the timing of the spawn and the area influenced by the spill.

Specific effects of oil on organisms can include direct lethal toxicity, sublethal disruption of physiological processes (internal lesions), effects of direct coating by oil (suffocation by coating gills), incorporation of hydrocarbons in organisms causing tainting or accumulation in the food chain, and changes in biological habitat (Moore and Dwyer, 1974).

The toxicity of an oil spill depends on the concentration of the hydrocarbon components exposed to the organisms (in this case fish and shellfish) and the variation of the sensitivity of the species considered. The effects on and the extent of damage to fisheries resources from a petroleum spill are restricted by time and location. Oil has the potential to affect finfish through direct ingestion of hydrocarbons or ingestion of contaminated prey. Hydrocarbon uptake of prey can be by dissolved petroleum products through the gills and epithelium of adults and juveniles, decreased survival of larvae, and through the death of eggs (NRC, 1985 and 2003). It can also result in incorporations of hydrocarbons in organisms causing tainting or accumulation in the food chain and changes in the biological habitat (Moore and Dwyer, 1974).

The level of impacts of oil on fish depends on the amount of oil released, the toxicity of the oil, and the availability of bacteria to degrade the oil. The speed of degradation of the oil by bacteria is also related to the water temperature. Physical toxicity of oil to fishes depends on the application of dispersants and the toxicity of the dispersant. In the case of the DWH event, the application of the dispersant (*Corexit 9500*) at the seafloor and the surface was alleged to have had the potential to produce larger areas of subsurface anoxic water because of the degradation of oil by bacteria. The effect of oil on fishes is also related to the distance from the shore, the location in the GOM, and the time of the year that the spill occurs. In the case of the DWH event, however, few offshore and onshore fish kills have been observed in Louisiana (Bourgeois, official communication, 2010) and none have been observed in Texas (Fisher, official communication, 2010).

Accidental spills have the potential to affect sensitive species in the Gulf of Mexico, such as the bluefin tuna that spawn in the Gulf of Mexico in April-May (Block et al., 2001). The western Atlantic stock has suffered a significant decline in spawning stock biomass since 1950, and a 20-year rebuilding plan has failed to revive the population or the North American fishery. The failure of the GOM spawning population to rebuild, as well as the scope of illegal and under-reported catches (particularly in the Mediterranean Sea) are of such major concern that the species was recently considered by the Convention for International Trade in Endangered Species for endangered species' listing in March 2010. More recently, as a result of a petition by the Center for Biological Diversity, NMFS has announced a 90-day finding for a petition to list Atlantic bluefin tuna as endangered or threatened under the Endangered Species Act and to designate critical habitat concurrently with a listing (*Federal Register*, 2010f). On May 27, 2011, NOAA announced that, at this time, the Atlantic bluefin tuna does not warrant species protection under the ESA (USDOC, NOAA, 2011c). Because of their decline in stock from overfishing, the timing of their spawn in the Gulf, their buoyant eggs, and the timing of the DWH event, there is concern about further decline in the western Atlantic stock of blue fin tuna due to potential impacts on the spawning area in the CPA and farther east. The WPA does not contain any known spawning areas for the western Atlantic stock of bluefin tuna.

In the case of the DWH event's resulting spill (consisting of a combination of oil and gas), it has been suggested that the addition of dispersants at the seafloor has resulted in large subsurface clouds of elevated methane concentrations. These alleged areas of elevated methane concentrations may potentially result in areas of lowered dissolved oxygen concentrations due to the actions of methanotrophic bacteria. Literature on this subject is scarce, so little is really known about the effects of methane on fish. Methane gas (CH_4) is commonly found in the Gulf of Mexico in concentrations of 6×10^{-5} ml/L to 125×10^{-5} ml/L in the Gulf of Mexico (Frank et al., 1970). Patin (1999) reported elevated concentrations of methane in the Sea of Asov resulting from gas blowouts from drilling platforms. He reported that these levels resulted in significant species' specific pathological changes. These include damages to cell membranes, organs, and tissues; modifications of protein synthesis; and other anomalies typical for acute poisoning of fish. However, these impacts were observed at levels of 1-10 ml/L, which is higher than the background levels in the Gulf of Mexico.

Recently published research (Kessler et al., 2011) revealed that a large amount of methane was released by the DWH event and, based upon the methane and oxygen distributions measured at 207 stations in the affected area, a large amount of oxygen was respired by methanotrophs. Kessler et al. suggest that the methane triggered a large methanotroph bloom that rapidly degraded the methane, leaving behind a residual methanotrophic community.

The effect of petroleum spills on fish resources as a result of the proposed action is expected to cause a minimal decrease in fish resources or standing stocks of any population. At the expected level of impact, the resultant influence on fish populations within or in the general vicinity of the proposed lease sale area would be negligible and indistinguishable from natural population variations.

Summary and Conclusion

Accidental events that could impact fish resources and EFH include blowouts and oil or chemical spills. Subsurface blowouts, although highly unlikely, have the potential to adversely affect fish resources. If spills due to the WPA proposed action were to occur in open waters of the OCS proximate to mobile adult finfish or shellfish, the effects would likely be nonfatal and the extent of damage would be reduced due to the capability of adult fish and shellfish to avoid a spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds (Chapter 4.4.10 of the Multisale EIS). Fish populations would be primarily affected if the oil reaches the productive shelf and estuarine areas, where fish populations are most concentrated, and this probability is generally low. Also, much of the coastal northern Gulf of Mexico is a moderate- to high-energy environment; therefore, sediment transport and tidal stirring should reduce the chances for oil persisting in these habitats if they are oiled.

The effect of proposed-action-related oil spills on fish resources is expected to cause a minimal decrease in standing stocks of any population because the most common spill events would be small in scale and localized; therefore, they would affect generally only a small potion of fish populations. Historically, there have been no oil spills of any size that have had a long-term impact on fishery populations. Although many potential effects of the DWH event on fish populations of the GOM have been alleged, the actual effects are at this time unknown and the total impacts are likely to be unknown for several years. The BOEMRE has determined that it cannot obtain this information, regardless of cost, within the timeframe of this NEPA analysis, and it may be years before the information is available. In the meantime, as described above, where this incomplete information is relevant to reasonably foreseeable impacts, it was determined if it was essential to a reasoned choice among alternatives and if not, scientifically credible information that is available was used in its stead and applied using accepted methodology.

4.1.1.13.4. Cumulative Impacts

Background/Introduction

A detailed description of cumulative impacts on fish resources and EFH can be found in Chapter 4.5.10 of the Multisale EIS and in Chapter 4.1.11.4 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in those documents, and incorporates new information found since publication of the 2009-2012 Supplemental EIS.

This cumulative analysis summary includes effects of the OCS Program (the proposed action and past and future OCS lease sales), State oil and gas activity, coastal development, crude oil imports by tanker, commercial and recreational fishing, and natural phenomena. Specific types of impact-producing factors considered in this cumulative analysis include cumulative onshore impacts such as (1) wetland loss as a result of environmental degradation and natural factors, e.g., hurricane loss of wetlands; (2) marine environmental degradation, including factors affecting marine hypoxia; (3) physical disturbance of live-bottom features, including non-OCS-related disturbances such as those related to commercial and recreational fishing; (4) the removal of production structures; (5) petroleum spills; (6) subsurface blowouts; (7) pipeline trenching; and (8) offshore discharges of drilling mud and produced waters. All of these subjects are discussed at length in Chapter 4.5.10 of the Multisale EIS and in Chapter 3 of the 2009-2012 Supplemental EIS.

Wetland Loss

The most serious impact to coastal EFH is the cumulative effects on wetlands that are occurring at an ever-increasing rate. This is primarily from the population increase, and associated development relating to this population increase, of the Gulf Coast States and the recent effects of major storms on wetland loss. The cumulative impacts of pipelines; canal dredging to accommodate commercial, residential, and recreational development; and major storm events (i.e., Hurricanes Katrina and Rita, 2005; Hurricanes Gustav and Ike, 2008) to wetlands are described in Chapter 4.5.3.2 of the Multisale EIS, in Chapter 4.1.3.2.4 in the 2009-2012 Supplemental EIS, and in **Chapter 4.1.1.4.4** of this Supplemental EIS.

In comparison to the large area of wetland loss to commercial and recreational (such as marinas and camps) development as well as to natural forces such as hurricanes, the incremental wetland losses due to the WPA proposed action are anticipated to be minimal.

Marine/Estuarine Water Quality Degradation

The coastal waters of Texas and especially Louisiana are expected to continue to experience nutrient overenrichment, periods of low-dissolved oxygen, and toxin and pesticide contamination. This results in the loss of both commercial and recreational uses of the affected waters. Fish kills and shellfish-ground closures would likely increase in numbers in the coming years based on impacts from these non-OCS-related impacts described above. Localized, minor degradation of coastal water quality is expected from the proposed action within the immediate vicinity of the waterbodies proximate to the proposed service bases, commercial waste-disposal facilities, and gas processing plants as a result of routine effluent discharges and runoff. Only a small amount of dredging would occur as a result of the WPA proposed action.

The incremental contribution of the proposed action, because the input of effluent, runoff, and nutrients from such action is very limited, would be a very small part of the cumulative impacts to coastal water quality.

Damage to Live Bottoms

Non-OCS sources of impacts on biological resources and the structure of live bottoms include natural disturbances (e.g., turbidity, disease, and storms), anchoring by recreational and commercial vessels, and commercial and recreational fishing. These impacts may result in severe and permanent mechanical damage at various scales to live-bottom communities. Fishing activities that could impact live bottoms would include trawl fishing and trap fishing. These techniques and their impacts are described in detail in the Chapter 4.5.10 of the Multisale EIS.

The OCS-related activities that could impact the biological resources and the structure of live bottoms are the anchoring of vessels, emplacement of structures (drilling rigs, platforms, and pipelines), sedimentation (operational waste discharges, pipeline emplacement, explosive removal of platforms, and blowouts), and chemical contamination (produced water, operational waste discharges, and petroleum spills). Live-bottom features in the WPA consist of the East and West Flower Garden Banks and Sonnier and Stetson Banks. The Topographic Features Stipulation, enacted by this Agency and clarified in its NTL 2009-G39, would prevent most of the potential impacts on live-bottom communities and EFH from any OCS Program activities by focusing OCS activities at specified distances from the topographic features, thereby increasing the distance between the topographic features and routine activities and potential accidental event. In the case of a spill, this distance would reduce the potential for contact with the features, as the released oil would be expected to rise to the surface and disperse in the water.. The OCS Program activities impacting live-bottom communities include bottom-disturbing activities (anchoring, structure emplacement and removal, and pipeline trenching), operational offshore waste discharges (drilling mud and cuttings, and produced waters), and any nearby blowouts.

Because there are more prevalent natural factors and non-OCS sources that can affect live bottoms and because the OCS factors that can affect live bottoms have been mitigated by BOEMRE, the OCS factors are anticipated to be a small portion of impacts to live bottom features in the WPA. Therefore, the incremental impact of the proposed action would be small in comparison.

Structure Removals

Structure removals would result in artificial habitat loss. It is estimated that 19-33structures would be removed as a result of the OCS Program in the WPA (**Table 3-2**). It is expected that structure removals would have an effect on fish resources near the removal sites when explosives are used (14-25 structures are expected to be removed by explosives, **Table 3-2**). However, only those fish proximate to sites removed by explosives would be killed. These expected impacts to fish resources have been shown to be small overall and would not alter determinations of status for impacted species or result in changes in management strategies (Gitschlag et al., 2000). But, this effect would be limited to the immediate area of the structure removal and would not rise to the level of a population impact.

Petroleum Spills

Spills that contact coastal bays, estuaries, and offshore waters when pelagic eggs and larvae are present have the greatest potential to affect fish resources. If spills occur in these coastal environments or waters of the OCS that are proximate to mobile adult finfish or shellfish, the effects would likely be nonfatal. The extent of this damage would be reduced due to the capability of adult fish and shellfish to avoid a spill, to metabolize hydrocarbons, and to excrete both metabolites and parent compounds (Chapter 4.4.10 of the Multisale EIS). For eggs and larvae contacted by spilled oil, the effect is expected to be lethal. The numbers and sizes of coastal spills for the 40-year program resource projection are presented in Table 4-13 of the Multisale EIS. About 90 percent of these spills are projected to be from non-OCS-related activity. Of coastal spills <1,000 bbl, the assumed size is 5 bbl, therefore coastal spills would affect a very small area and dissipate rapidly (Table 4-13 of the Multisale EIS). The small coastal spills that do occur from OCS-related activity would originate near terminal locations in the coastal zones of the WPA.

One large (≥1,000 bbl) offshore spill is projected to occur annually from the Gulfwide OCS Program (Table 4-13 of the Multisale EIS), and a total of 1,500-1,800 small offshore spills (<1,000 bbl) are projected annually. Of these, 450-500 would originate from OCS Program sources. Chapter 4.3.1.2 of the Multisale EIS describes projections of future spill events in more detail. The impacts of a catastrophic spill, such as the DWH event, in the WPA are discussed in **Appendix B** with the currently available data.

Because spills are a low-probability event, both in the inshore and the OCS area, the proposed action's incremental impact on EFH and fish populations in the WPA is not anticipated to be significant as a result of proposed WPA Lease Sale 218.

Subsurface Blowouts

Subsurface gas blowouts of both oil and natural gas wells have the potential to affect adversely fishery resources. Loss of well control and resultant blowouts seldom occur on the Gulf of Mexico OCS. Considering the entire OCS Program during the 40-year analysis period, it is projected that there would be 63-75 blowouts out of 8,160-9,662 development wells (<1%) for all water depths in the WPA (Table 4-5 of the Multisale EIS). Sandy sediments would be quickly redeposited within 400 m (1,312 ft) of a blowout site, and finer sediments would be widely dispersed and redeposited within a few thousand feet or meters over a period of 30 days or longer. Impacts on fish populations from these events are expected to be undetectable because they would be localized and temporary in nature. It is expected that the infrequent subsurface natural gas blowout that may occur on the Gulf of Mexico OCS would have a negligible effect on offshore fish resources, again because they would be localized and temporary and would not rise to population level impacts.

Subsurface blowouts, such as the DWH event, that include both oil and natural gas have the potential to affect fish populations, particularly eggs, larvae, and juveniles. Spills from this type of a blowout are a low-probability event, so the cumulative impact on EFH and fish populations is not anticipated to be large as a result of proposed WPA Lease Sale 218.

Pipeline Trenching

Sediment would potentially be resuspended during the installation of pipelines. A total of 130-760 km (80-472 mi) of pipeline is projected to be installed in the WPA (only in the water depth category of <60 m or 200 ft) during the 40-year analysis period (**Table 3-2**). Although in shallower waters pipeline installation may involve trenching, in waters over 200 ft (61 m), pipelines are typically laid on the surface without resorting to trenching, thereby limiting suspension of sediments in waters over 200 ft (61 m). In many areas of the Gulf of Mexico, sediments are not static, as evidenced by the relatively recently discovered deep-sea furrows (Bryant et al., 2004).

Because the contribution of resuspended sediment as a result of pipeline trenching and installation compared with the natural movement and suspension of sediments (e.g., currents, tidal influences, and hurricanes) on the seafloor is very small, the effect on fish resources from pipeline trenching is expected to be minimal.

Discharges of Drilling Mud and Produced Waters

Drilling mud discharges contain chemicals toxic to marine fishes. These concentrations of toxins are four or five orders of magnitude higher at the wellhead than those found more than a few meters or feet from the discharge point. Offshore discharges of drilling mud dilute to near background levels within 1,000 m (3,280 ft) of the discharge point and would have a negligible effect on the fishery.

Produced-water discharges contain components and properties detrimental to fishery resources. These include petroleum hydrocarbons, trace metals, radionuclides, and brine. Limited petroleum concentrations and metal contamination of sediments and the upper water column would occur out to several hundred meters or feet down current from the discharge point. Offshore discharges of produced water disperse and dilute to near background levels within 1,000 m (3,280 ft) of the discharge point and have a negligible effect on fisheries. Offshore live bottoms would not be impacted. Offshore discharges and subsequent changes to marine water quality are regulated by U.S. Environmental Protection Agency NPDES permits. Biomagnification of mercury in large fish of higher trophic levels is a problem in the GOM, but there is no documentation that this mercury comes from OCS sources compared with the many other sources of mercury in these waters.

Summary and Conclusion

Activities resulting from the OCS Program and non-OCS events in the northern GOM have the potential to cause cumulative detrimental effects on fish resources and EFH. Impact-producing factors of the cumulative scenario that are expected to substantially affect fish resources and EFH include coastal and marine environmental degradation, overfishing, and to a lesser degree, coastal petroleum spills and coastal pipeline trenching. The implementation of proposed lease stipulations and mitigation policies, the probability of an oil spill, and that flow regimes are not expected to change further reduces the incremental contribution of stress from the WPA proposed action on coastal habitats. The proposed Live Bottom (Low Relief) Stipulation and guidelines in NTL's 2009-G39 and 2009-G40 would limit the potential impact of any activities on deepwater EFH because the stipulations and NTL's keep the sources of such adverse events geographically removed from EFH. Decreases of impacts to EFH will decrease the impacts of similar activities on fish resources. At the estimated level of cumulative impact, the resultant influence on fish resources and EFH is expected to be substantial, but not easily distinguished from effects due to natural population variations.

The incremental contribution of the WPA proposed action to the cumulative impacts on fish resources and EFH is small, as analyzed in Chapters 4.2.1.1.8, 4.4.10, and 4.5.10 of the Multisale EIS. The effects of impact-producing factors (e.g., coastal and marine environmental degradation, petroleum spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling mud and produced waters) related to the WPA proposed action are expected to be negligible and virtually undetectable among the other cumulative non-OCS-related impacts and natural population variability.

4.1.1.14. Commercial Fishing

The BOEMRE has reexamined the analysis for commercial fishing presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusion for commercial fishing presented in the Multisale EIS and the 2009-2012 Supplemental EIS.

The full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS. A summary of those analyses and their reexamination due to new information is presented in the following sections. A brief summary of potential impacts follows. Routine activities in the WPA, such as seismic surveys and pipeline trenching, would cause negligible impacts and would not deleteriously affect commercial fishing activities. Indirect impacts from routine activities to inshore habitats are negligible and indistinguishable from direct impacts of inshore activities on commercial fisheries. The potential impacts from accidental events (i.e., a well blowout or an oil spill) associated with the WPA proposed action are anticipated to be minimal. Commercial fishermen are anticipated to avoid the area of a well blowout or an oil spill. Any impact on catch or value of catch would be insignificant compared with natural variability. The incremental contribution of the proposed action to the cumulative impacts on commercial fishing is small, and it is expected to be negligible and indiscernible from natural fishery population variability.

4.1.1.14.1. Description of the Affected Environment

Detailed descriptions of commercial fishing can be found in Chapter 3.3.1 of the Multisale EIS and in Chapter 4.1.12.1 of the 2009-2012 Supplemental EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Finfish

Commercial fishing regulations are detailed and change on a regular basis depending on a variety of factors, including stock assessment and catch statistics. Changes can occur on short notice, especially time closures based on allowable catches. The Gulf of Mexico Fishery Management Council (GMFMC) provides the current information on commercial and recreational fishing rules for U.S. Federal waters of the GOM (GMFMC, 2010a and 2010b).

Menhaden, with landings of over 1 billion pounds and valued at $60.5 million, was the most important Gulf species in terms of quantity landed during 2009. The menhaden catch was up from 927.5 million pounds, worth $64.3 million, in 2008 in the Gulf of Mexico, although the price per pound was down (USDOC, NMFS, 2010c).

In the WPA, a total of approximately 4.1 million pounds of finfish were landed in 2009 and were worth approximately $7.5 million. Black drum was the largest catch at approximately 1.6 million pounds. Black drum has consistently been the largest catch in Texas since 2005. Red snapper followed by Vermilion snapper have been the second and third largest catch, respectively, in Texas since 2005. In 2009, approximately 0.9 million pounds of red snapper and 0.6 pounds of Vermilion snapper were harvested in Texas.

Shellfish

Shrimp (brown, pink, royal red, and white), with landings of over 256.5 million pounds and valued at about $314 million, were the most important shellfish in terms of value landed during 2009. Shrimp production was up throughout the Gulf from 186.3 million pounds in 2008 to 256.5 million pounds in 2009, although the price was down from $356.3 million in 2008 to $313.7 million in 2009. Blue crabs, another of the most valued shellfish of the Gulf Coast, produced 59.1 million pounds in 2009 worth approximately $43.7 million (USDOC, NMFS, 2010c).

The shellfish (shrimp and crabs) harvest in 2008 was approximately 99.5 million pounds worth approximately $150.2 million. Shrimp harvest alone was 62.9 million pounds, worth $153.9 million (USDOC, NMFS, 2010c).

The American oyster (*Crassostrea virginica*) is also harvested in Texas estuaries from Galveston Bay west to East Matagorda Bay. Historically, the largest oyster harvest in Texas comes from Galveston Bay because of its favorable salinity regime. In 2008, the total harvest of oyster meats from Texas was 2.7 million pounds worth approximately $8.8 million dollars. This is down from 5.6 million pounds worth approximately $19.3 million in 2007, a 110 percent decrease in harvest. Oyster harvest in Galveston Bay was down 0.7 million pounds (-38%) in 2008, and the oyster harvest in San Antonio Bay was down 1.1 million pounds of meats (-1,408%). Harvest of oyster meats decreased in all bays across the coast with the exception of East Matagorda Bay where the harvest, although small (9,700 pounds), was up 71 percent in 2008 over the 2007 harvest of 2,800 pounds (Fisher, official communication, 2010). Most of the decrease can be attributed to Hurricane Ike.

In September 2008, Hurricanes Gustav and Ike made landfall on the Gulf Coast. Hurricane Gustav came ashore southwest of New Orleans as a Category 2 storm, and Hurricane Ike made landfall as a Category 2 storm at Galveston, Texas. Hurricane damage sustained by the fisheries in Galveston Bay as a result of Hurricane Ike, with emphasis on the oyster infrastructure, is documented by Haby et al. (2009). This report estimates losses in excess of $31 million, including private leases, docks, fuel systems, plants, and inventories in the oyster industry alone, although docks and fuel systems often serve multiple commercial as well as recreational fisheries.

Large amounts of silt were deposited on oyster beds in Galveston Bay by Hurricane Ike. The Texas Parks and Wildlife Department currently has two oyster reef restoration projects underway in Galveston Bay. The larger of these projects involves planting 20 ac (8 ha) of cultch in East Bay, an area heavily silted by Hurricane Ike, to rebuild reef commercial reef (Texas Parks and Wildlife Department, 2009).

The DWH event, which affected much of the Gulf of Mexico, was largely to the east of Texas. There were no fishery (recreational or commercial) closures in Texas or the WPA, no oyster bed closures, and only a single report of limited tarballs on Bolivar Peninsula and Galveston Island (Fisher, official communication, 2010). Although the tarballs were linked to the DWH event, the oil was lightly weathered and likely did not travel to the beaches from the source of the spill; it is more likely that the tarballs resulted from oil transported into the WPA by a response vessel (RestoretheGulf.gov, 2010a). There is no evidence that tarballs reached the oyster beds in Galveston Bay, behind Galveston Island, although these oyster beds are still suffering the effects of previous hurricanes, particularly Hurricane Ike. As such, the limited presence of tarballs would not appear to be relevant to the status of shellfish in the WPA.

Stock Status

The NOAA Fisheries reports each year to the Congress and Fishery Management Councils on the status of all fish stocks in the Nation. As of the 2010 status report (USDOC, NMFS, 2011f), they reviewed 522 individual stocks and stock complexes, and made determinations of overfishing and overfished for 193 stocks and complexes; an additional 67 stocks have either an overfishing or overfished determination. Overfishing is harvesting at a rate above a prescribed fishing mortality threshold, and overfished is defined as a stock size that is below a prescribed biomass threshold. Species that are currently listed as subject to overfishing in the Gulf of Mexico are red snapper, greater amberjack, gag grouper, and gray triggerfish. All of these species occur throughout the GOM in and around reefs. The effects of the DWH event on each of these species are unknown at this time. For the WPA, BOEMRE anticipates that impacts to these species, on a population level, would be minor, given that the lateral extent of the plume and sheen remained east of the WPA boundary and that there were no fishery closures within the WPA. For this reason, incomplete or unavailable information on the effects of DWH on these stocks would not be expected to be relevant to reasonably foreseeable significant adverse impacts at the population level.

Economics of Commercial Fisheries

The commercial fishing industry is an important component to the economy of the Gulf of Mexico. **Table 4-7** provides an overview of the economic significance of the commercial fishing industry in the Gulf of Mexico (USDOC, NMFS, 2010c). Commercial fishing landings in the Gulf were worth over $700 million in 2008. Texas had around $170 million in landings. Detailed information regarding the catch rates and prices paid for individual species in each Gulf Coast State can be obtained through NMFS's economics report (USDOC, NMFS, 2010c). Further information on fishing harvests at individual Gulf Coast ports is also available.

Landings revenue also supports economic activity along the commercial fishing supply chain. **Table 4-7** presents estimates of sales and employment in the economy that depend on commercial fishing activity. Approximately $10 billion in combined sales activity and over 200,000 jobs depend directly or indirectly on commercial fishing in the Gulf of Mexico. Texas has approximately 40,000 jobs in the industry. More detailed breakdowns of sales and employment statistics in each Gulf Coast State can be obtained through NMFS. The final column of **Table 4-7** presents the commercial fishing quotient, which is a measure of the concentration of the fishing industry in a particular state relative to the national average. Louisiana has the highest commercial fishing quotient in the Gulf of Mexico; its commercial fishing quotient of 2.5 means that the concentration of the fishing industry in Louisiana is 2.5 times that of the U.S. average. Texas and Alabama have the lowest commercial fishing quotients in the Gulf; the concentration of the commercial fishing industry in these states is roughly one-third the national average.

Although the DWH event impacted commercial fishing in the Gulf of Mexico as a whole, few if any impacts occurred in the WPA. This is based on the fact that the lateral extent of the spill and sheen associated with the DWH event remained east of the WPA boundary and that there were no fishing closures in the WPA because of the DWH event and spill. The majority of the impacts of the spill on commercial fisheries were felt in the CPA region and in Florida.

4.1.1.14.2. Impacts of Routine Events

Background/Introduction

The detailed description of possible impacts on commercial fishing from routine activities associated with the WPA proposed action is given in Chapter 4.2.1.1.9 of the Multisale EIS and in Chapter 4.1.12.2 of the 2009-2012 Supplemental EIS. The BOEMRE has reexamined the impacts of WPA activities on the commercial fisheries resources. A search was conducted for new information published since completion of the Multisale EIS and the 2009-2012 Supplemental EIS. A search of Internet information sources (including scientific journals), and interviews with personnel from academic institutions and governmental resource agencies was conducted to determine the availability of new information. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Direct effects on commercial fishing from routine offshore activities could result from the installation of production platforms, underwater OCS obstructions including pipelines, production platform removals, seismic surveys, and the discharge of offshore waste.

Offshore structures can cause space-use conflicts with commercial fishing, especially with longline fishing. Exploratory drilling rigs cause temporary interference to commercial fishing, lasting approximately 30-150 days. Major production platforms present a permanent area unavailable for fishing that includes structures and safety zones. Underwater OCS obstructions such as pipelines can cause loss of trawls and catch, as well as fishing downtime and vessel damage.

Production platform decommissioning and removal activities in water depths <200 ft (61 m) remove artificial reef habitat and often involve the use of explosives. This is lethal to fish that have internal air chambers (swim bladders), are demersal, and are in close association with the structure or are transitory in the area. Intense sounds generated by seismic surveys affect the spatial distribution of fish during and for some period following exposure. These impacts are limited to the immediate area of the decommissioning activity and to those fish that happen to be at the platform at the time of the use of explosives. As such, these impacts are limited geographically and temporally, and would not be expected to rise to population-level impacts.

The most commonly discharged offshore wastes are drill mud and produced water. Drill mud contains metals such as mercury and cadmium, which are toxic to fishery resources. Produced water commonly contains brine, trace metals, hydrocarbons, organic acids, and radionuclides. Any or all of these constituents, in high enough concentration, can be toxic to fish at any stage of their life cycle. Additionally, routine offshore activities may impact inshore commercial fisheries indirectly. These activities include the construction or expansion of onshore facilities in wetland areas, pipeline emplacement in wetland areas, vessel usage of navigation channels and access canals, maintenance of navigation channels, and inshore disposal of OCS-generated, petroleum-field wastes.

Degradation of coastal water quality may indirectly impact commercial fisheries. Coastal water quality (discussed at length in Chapter 4.2.1.1.2.1 of the Multisale EIS and in Chapter 4.1.2.1.2 of the 2009-2012 Supplemental EIS) may be affected adversely by saltwater intrusion and sediment disturbances from channel maintenance dredging, onshore pipeline emplacements, and canal widening. These factors potentially also affect the quality and quantity of wetlands and the quality of estuaries. Many commercial fish in the offshore Gulf of Mexico depend on these resources as nursery habitat. Trash, discharges, and runoff may be released from onshore facilities and vessel traffic, and may cause degradation of coastal water quality. Besides coastal sources, trash occurring in association with OCS operations and reaching coastal waters may impact water quality conditions. Marine environmental degradation resulting from routine offshore activities also has the potential to indirectly affect commercial fish resources by reducing food stocks in soft-bottom and reef habitats. These routine activities include the offshore discharge of produced water and drilling mud.

Proposed Action Analysis

The routine activities associated with the WPA proposed action that would impact commercial fisheries include installation of production platforms, underwater OCS obstructions, pipeline trenching, production platform removals, seismic surveys, and the discharge of offshore waste.

The number of production structures projected as a result of the WPA proposed action ranges from 26 to 41. Applying a 500-m (1,640-ft) safety zone around a platform would exclude approximately 193 ac (78 ha) from commercial fishing, assuming that the operator applied to USCG for a safety zone around the platform. The total number of platforms projected in the WPA in <200 m (656 ft), the area in which concentrated bottom trawling occurs, is 21-33, thus potentially excluding 1,640-2,577 ha (4,053-6,369 ac) or <0.01 percent from the total area available to trawling.

Commercial fisheries conflicts with platforms in water deeper than 200 m (656 ft) are limited to the longline fishery. Surface-drifting longlines may contact a deepwater platform if not set an appropriate distance from the surface-piercing structure. The area of a surface-piercing structure is very small in relation to the total area available to longliners.

The number of kilometers of pipeline projected to be emplaced in the WPA in water depths <60 m (200 ft) is from 60 to 420 km (37 to 261 mi). Because of pipeline burial requirements, it is assumed that installed pipelines would seldom conflict with bottom trawling activities in water depths <60 m (200 ft) and would not conflict with commercial fishing in deeper waters.

Structural removals in water depths <200 m (656 ft) result in a loss of artificial habitat and in fish mortality when explosives are used. It is projected that 14-24 removals would occur in the WPA in water depths <200 m (656 ft) as a result of the proposed action, making approximately 1,093-1,875 ha (2,702-4,632 ac) available again for commercial fishing. It is expected that structure removals would have a negligible impact on commercial fishing because of the small number of removals and the consideration that removals kill primarily those fish associated with the platforms.

Seismic surveys would occur in both shallow and deep waters of the WPA. Seismic survey vessels are of temporary presence in any commercially fished area of the WPA. Temporal and spatial distributions of commercial species are not affected in areas adjacent to seismic surveys. The locations and schedules of seismic surveys are published in the USCG's "Local Notice to Mariners." Seismic surveys have a negligible impact on commercial fisheries because surveys are limited in time and space, and the observed fish response is to avoid the area of the survey for a short period of time. As such, these impacts would be limited to a small area and a matter of days.

Produced water and drill mud are discharged in shallow and deep waters of the WPA. Studies of drill mud and produced water from platforms show that the plume disperses rapidly in both cases and does not pose a threat to commercial fisheries. In a recent study of the concentrations of the bioavailable form of mercury (methylmercury) in drill mud, Trefry et al. (2003) found concentrations did not vary significantly between near-platform and far-platform sites (e.g., it is not significantly different from background concentrations.). Further, the study suggested that elevated levels of methylmercury in sediments around drilling sites are not a widespread phenomenon in the Gulf of Mexico (Trefry et al., 2003). As such, any impact to commercial fisheries would likely be indistinguishable from exposure to background concentrations.

Summary and Conclusion

Routine activities such as seismic surveys and pipeline trenching in the WPA would cause negligible impacts and would not deleteriously affect commercial fishing activities. Because seismic surveys are temporary events, they are not expected to cause significant impacts to commercial fisheries. Operations such as production platform emplacement, underwater OCS impediments, and explosive platform removal would cause displacement of commercial fishing while operations are ongoing. These effects are localized to a small percentage of the area fished and they are temporary in nature.

Commercial catches by species and by State have been updated in **Chapter 4.1.14.1**, as have the impacts of the 2005 and 2008 hurricanes on fish and fish habitat from recent reports (USDOC, NMFS, 2010d; Haby et al., 2009). The new information presented in this Supplemental EIS does not alter the conclusion presented in the Multisale EIS and the 2007-2009 Supplemental EIS that impacts on commercial fisheries from routine activities associated with the WPA proposed action would be minimal.

4.1.1.14.3. Impacts of Accidental Events

Background/Introduction

The description of possible impacts on commercial fisheries resulting from accidental events associated with the WPA action is presented in detail in Chapter 4.4.10 of the Multisale EIS and in Chapter 4.1.12.3 of the 2009-2012 Supplemental EIS. The risk of oil-spill events as a result of the proposed action was discussed at length in Chapter 4.3.1 of the Multisale EIS, and the potential effects of a spill on commercial fisheries is detailed at length in Chapter 4.4.10 of the Multisale EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Accidental events that would impact commercial fisheries include subsurface offshore blowouts and oil spills, both inshore and offshore. There is a small risk of spills occurring during shore-based support activities. The great majority of these shore-based spills would be very small, limited to the storage capacity, and shorter response time. Most of these incidents would occur at or near pipeline terminals or shore bases, and they are expected to affect a highly localized area with low-level impacts.

Proposed Action Analysis

The accidental events that would impact commercial fisheries include well blowouts, primarily gas well blowouts, and/or oil spills. Impacts of gas well blowouts on commercial fisheries are generally very localized and limited. Sediment redistribution would affect only the area within a few hundred yards of the blowout. Impacts of oil or oil/gas mixture blowouts may affect commercial fisheries populations, depending on their exposure to the oil, the type of oil, and the time of year of the spill. Most commercial species are only affected if the oil reaches the shelf or the inshore estuarine waters where they spend a portion of their life cycle.

Commercial fishermen would actively avoid the area of a small spill, but they may be prevented from fishing by State or Federal agency closures in some areas in the case of larger spills. Fish flesh tainting (oily tasting fish/shellfish) and resultant area closures could decrease commercial landings, value, or catch in the short term. Perception of tainting of commercial catches may affect the ability of commercial fishermen to sell their product.

Closure areas imposed by State or Federal agencies may also impact the commercial fisheries positively in the long term by easing fishing pressure on commercially (especially annually) harvested populations.

The effects of a catastrophic event, such as the DWH event, on commercial fisheries are preliminary and mostly speculative at this point. Data are unavailable, and it may take several years to acquire the necessary data and analyze it regarding long-term effects of the DWH event on all Gulf of Mexico commercial fisheries populations. The NRDA action will spearhead these efforts, but it has not published relevant data. Regardless of the costs of acquiring these data, given the realities of the NRDA process, these data will not be available within the timeframe contemplated for this NEPA analysis. In any event, this information is not essential to a reasoned choice among the alternatives because catastrophic events remain extremely low-probability events (**Appendix B**).

Blowout and Oil-Spill Impacts

An offshore subsurface blowout event, although highly unlikely, has the potential to affect fish within a few hundred feet of the blowout. A blowout at the seafloor can cause a crater that might interfere with longlining in the near vicinity or cause an area to be closed to longlining. A seafloor blowout could also result in a localized increase in suspended sediments. These sediments can clog finfish gills and interfere with respiration. Sediments remaining in suspension can cause interference in feeding in finfish species that are sight feeders. Coarse sediments such as sand-sized particles, however, fall out of the water column quickly, but finer sediments are redistributed by currents and settle out over a larger area.

Oil spills may occur from blowouts; however, most product loss from blowouts is natural gas, primarily methane, which rapidly dissolves in the water column or escapes into the air. Recently published research (Kessler et al., 2011) revealed that a large amount of methane was released by the DWH event and, based upon the methane and oxygen distributions measured at 207 stations in the affected area, a large amount of oxygen was respired by methanotrophs. Kessler et al. suggest that the methane triggered a large methanotroph bloom that rapidly degraded the methane, leaving behind a residual methanotrophic community. Any impacts are expected to have been temporary, and in general fish, including commercial stocks, typically avoid areas of low dissolved oxygen.

Most of the commercial fish and shellfish harvested in the WPA are estuarine dependent at some point in their life cycles. These include brown shrimp, white shrimp, pink shrimp, blue crabs, Atlantic croaker, sheepshead, menhaden, black drum, red drum, spotted sea trout, and sand sea trout. Oysters are most abundant in estuarine areas. Other species such as red snapper and king mackerel are most abundant on the shelf.

Oil spilled in the offshore areas is usually localized and has a very low probability of reaching shelf waters and coastal estuaries. Much of the oil volatilizes or is dispersed by currents in the offshore environment. Oil that is not volatilized, dispersed, or emulsified by dispersants, and through a combination of oceanographic and meteorological factors moves onto the shelf or into the estuaries, has the potential to affect finfish through direct ingestion of hydrocarbons or ingestion of contaminated prey. Impacts of oil spills can be via hydrocarbon uptake of prey, direct exposure of dissolved petroleum products through the gills and epithelium of adults and juveniles, decreased survival of larvae, and death of eggs (NRC, 1985 and 2003). All of these mechanisms are discussed at length in Chapter 4.4.10 of the Multisale EIS.

Actual effects of any oil that is released and comes in contact with the shelf or estuarine populations of commercially important species would depend on the API gravity of the oil, its ability to be metabolized by microorganisms, and the time of year of the spill. Effects on the populations would be at a maximum during the spawning season of any commercially important population, exposing larvae and juveniles to oil. Effects on commercial species may also include tainting of flesh or the perception of tainting in the market. This can, depending on the extent and duration of the spill, affect marketability of commercial species.

The effects on future generations of commercial fisheries depend on the mobility of the species and the length of their life cycles. Sessile species such as oysters would be affected more than species with the ability to avoid the oil. Species with short life cycles such as shrimp and crabs are most vulnerable because they are essentially an annual crop. Longer-lived species such as snapper and grouper have more resilience because these populations consist of multiple year classes that can breed, and the failure of any one year class does not necessarily threaten the survival of the population.

Closure areas imposed by State or Federal agencies may impact the commercial fisheries of an area either inshore in State waters or in the EEZ by easing fishing pressure on commercially harvested populations. Most of these short-lived estuarine dependent species, such as brown and white shrimp and blue crabs, are harvested on an annual basis. Closure to harvest relieves the annual fishing pressure and, assuming no devastation of the population due to the effects of oil, may actually increase population levels during the period of closure.

Recent data collected by Dauphin Island Sea Lab researchers from stations outside of the barrier islands and in the estuaries prior to and after the DWH event and resulting spill show a clear increase in biomass and abundance of estuarine species such as Atlantic croaker, spot, shrimp, and crabs (i.e., post-DWH spill). Species were most abundant in the estuaries (as compared with outer stations) both pre- and post-spill. The data also show the ratio between the total abundance of shrimp and crabs to Atlantic croaker and spot exhibited a huge decrease in the ratio after the spill (Valentine, official communication, 2010). Area closures may, therefore, have a somewhat positive impact on inshore commercial fisheries populations, even in the context of an accidental event.

Summary and Conclusion

The BOEMRE has reexamined the analysis for impacts to commercial fish resources presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on updated information obtained through the peer-reviewed data, Internet sources, and conversations with Gulf Coast State agencies, Federal agencies, and professors at local academic institutions. No significant, newly published, peer-reviewed information was found that would alter the overall conclusion that impacts to commercial fish resources from accidental activities associated with the WPA proposed action would be minimal. In summary, the impacts of the WPA proposed action from accidental events (i.e., a well blowout or an oil spill) are anticipated to be minimal because the potential for oil spills is very low, the most typical events are small and of short duration, and the effects are so localized that fish are typically able to avoid the area adversely impacted.

Fish populations may be impacted by an oil-spill event should it occur, but they would be primarily affected if the oil reaches the productive shelf and estuarine areas because many fish spend a portion of their life cycle there. The probability of an offshore spill impacting these nearshore environments is also low, and oil would generally be volatilized or is dispersed by currents in the offshore environment. The extent of the impacts of the oil would depend on the properties of the oil and the time of year of the event.

Commercial fishermen are anticipated to avoid the area of a well blowout or an oil spill. Fisheries closures may result from a large spill event. These closures may have a negative effect on short-term fisheries catch and/or marketability. In the long term, they may have a positive impact on annually harvested species because there was a decrease in fishing pressure on the stocks.

4.1.1.14.4. Cumulative Impacts

Background/Introduction

A detailed description of cumulative impacts on commercial fishing can be found in Chapter 4.5.11 of the Multisale EIS and in Chapter 4.1.12.4 of the 2009-2012 Supplemental EIS. The following is a summary of the information incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared. This information has been gathered from referenced journals, government agency publications, conversations with government resource agency employees, and the Internet.

Specific types of impact-producing factors considered in the cumulative analysis include the following: (1) commercial fishing techniques or practices; (2) wetland loss; (3) hurricanes; (4) installation of production platforms and underwater OCS obstructions; (5) production platform removals; (6) seismic surveys; (7) petroleum spills; (8) subsurface blowouts; (9) pipeline trenching; and (10) offshore discharges of drilling mud and produced waters.

Commercial Fishing Practices

There is competition among large numbers of commercial fishermen, among commercial operations employing different fishing methods, and between commercial and recreational fishermen for a given fishery resource. That competition, coupled with natural phenomena such as hurricanes, hypoxia, and red or brown tides, can impact commercial fishing activities. When practiced nonselectively, fishing techniques such as trawling, gill netting, or purse seining may reduce the standing stocks of the desired target species. This can also significantly affect species other than the target. In addition, continued fishing of most commercial species at the present levels can result in rapid declines in the landings and the eventual failure of certain fisheries.

Wetland Loss

The most serious impact to commercial fisheries is the cumulative effects on wetlands that are occurring at an ever-increasing rate. This is primarily from the population increase, and associated development relating to this population increase, of the Gulf Coast States and the recent effects of major storms on wetland loss. Wetland conversion to open water would result in a permanent loss of nursery and foraging habitat for many commercial fish stocks. In comparison to the large area of wetland loss to commercial and recreational (such as marinas and camps) development as well as to natural forces such as hurricanes, any incremental wetland loss due to the WPA proposed action would be minimal.

Hurricanes

Hurricanes may impact commercial fishing by damaging gear and shore facilities, and by dispersing resources over a wide geographic area. Hurricanes may also affect the availability and price of key supplies and services (e.g., fuel) that also affect commercial fishing. Hurricanes suspend fishing activity and are destructive to wetlands that act as nursery grounds to many commercial fish. Hurricanes can be extremely destructive to oyster beds by causing siltation over the beds and smothering spat along with adult oysters as evidenced by Hurricanes Katrina, Rita, Gustav, and Ike. Commercial fisheries landings of the central Gulf Coast were drastically impacted by Hurricanes Katrina and Rita in 2005 as a result of the severe impact on coastal port facilities and fishing vessels. These data are discussed in detail in Chapter 3.3.1 of the Multisale EIS. Equally as destructive were Hurricanes Gustav and Ike in 2008, as discussed in **Chapter 3.3.7.2** of this Supplemental EIS. These impacts were so severe that Commerce Secretary Gutierrez determined a fisheries resource disaster as a result (Upton, 2010). However, natural disaster impacts such as these are easily distinguished from incremental impacts of OCS activities.

Installation of Production Platforms and Underwater Obstructions

The WPA proposed action is anticipated to result in the installation of 26-41 new production facilities (**Table 3-2**). These production facilities compete with commercial fishing interests for physical space in the open ocean. The facilities can also be associated with underwater OCS obstructions that pose hazards to fishing nets. These facilities are also known fish attracting devices, so fish often congregate around them for food and shelter from predators. The area occupied by these structures is small compared with the area available in the WPA for fishing. Because the footprint area of OCS structures is small and easily avoided by fishing vessels, the cumulative impact of proposed WPA Lease Sale 218 to the commercial fisheries of the WPA is anticipated to be small.

Platform Removals

Offsetting the anticipated installation of platforms in the WPA is the anticipated removal of 19-33 existing platforms (**Table 3-2**). The removal of these platforms not only frees the area for commercial fishing but also removes them as fish attracting devices. There is the possibility the structures can be used in a rigs-to-reef program where they would serve as artificial habitat for fish. Of those estimated to be removed, 14-25 are anticipated to be removed using explosives (**Table 3-2**). Explosives cause mortality in fish with swim bladders when they are either associated with the platform or transient in the area at the time of the explosions but these impacts would be localized to the immediate area of concern and would be short term. Because the number of platform removals is small, the effects on commercial fishery populations are expected to be minimal.

Seismic Surveys

Seismic surveys are used in both shallow- and deepwater areas of the Gulf of Mexico. Seismic surveys are limited in time and space, and the observed fish response is to avoid the area of the survey for a short period of time. Although it has been alleged that catch rates are lower after seismic surveys, fishermen are usually precluded from the area for several days. This should not significantly affect the annual landings or the value of landings for commercial fisheries because Gulf of Mexico species are found in many adjacent locations and Gulf commercial fishermen do not fish in one locale.

Petroleum Spills

The potential causes, sizes, and probabilities of petroleum spills that could occur during activities associated with the WPA proposed action are discussed in detail in **Chapter 3.2.1**. One large (≥1,000 bbl) offshore spill is estimated to occur annually from all sources Gulfwide (Chapter 4.3.1.5.1 of the Multisale EIS). Large spills can potentially affect commercial fisheries resources by causing potential losses to commercial fish populations. These potential population losses may be offset by commercial fisheries closure areas necessitated by a large spill. The effects of a catastrophic spill such as the DWH event, although based on limited data at this time, are discussed in **Appendix B**. Although the effects can be significant from any one spill, the overall probability of a large spill occurring is still low.

The size of non-OCS-related spills in the WPA is expected to be small and to cause a minimal decrease in commercial fishing local to the spill area. Because these spills are small, the resultant influence on commercial fishing, landings, or the value of those landings is not expected to be distinguishable from natural population variations.

Subsurface Blowouts

Subsurface blowouts of oil and natural gas wells and pipeline trenching have the potential to adversely affect commercial fishery resources. The loss of well control and resultant blowouts seldom occur in the Gulf OCS over a 40-year time period (63-75 blowouts out of 10,485-12,526 wells drilled, i.e., <1%) (Table 4-5 of the Multisale EIS). Sandy sediments are quickly redeposited within 400 m (1,312 ft) of a blowout site, and finer sediments are widely dispersed and redeposited within a few thousand meters or feet over a period of 30 days or longer. These events are expected to have a negligible impact on fish populations. It is expected that the infrequent subsurface natural gas blowout that can occur on the Gulf of Mexico OCS would have a negligible effect on commercial fish resources.

Subsurface blowouts, such as the DWH event, that include both oil and natural gas have the potential to affect fish populations, particularly eggs, larvae, and juveniles. The specific effects of this type of spill on individual fish populations in the Gulf of Mexico are currently unknown, and spills of this type are a low-probability event. Because these spills are a low-probability event, the contribution to the cumulative impact on commercial fisheries populations is not expected to be large as a result of proposed WPA Lease Sale 218.

Pipeline Trenching

Pipeline trenching also has the potential to affect commercial fisheries as a result of sediment suspension. Sandy sediments are quickly redeposited within 400 m (1,312 ft) of a trench, and finer sediments are widely dispersed and redeposited over a period of hours to days within a few thousand meters of the event. No significant effects to commercial fisheries are anticipated as a result of oil or gas well blowouts or pipeline trenching. Resuspension of vast amounts of sediments as a result of large storms and hurricanes occurs on a regular basis in the northern Gulf of Mexico (<50 m; 164 ft) (Hu and Muller-Karger, 2007). In many areas of the Gulf of Mexico, sediments are not static under natural conditions, as evidenced by the recently discovered deep-sea furrows (Bryant et al., 2004).

The cumulative effect on commercial fisheries from oil and gas well blowouts in the Gulf OCS and pipeline trenching is not expected to be distinguishable from natural events or natural population variations.

Offshore Discharge of Drilling Mud and Produced Waters

Drilling mud discharges contain chemicals toxic to marine fishes, including brine, hydrocarbons, radionuclides, and metals. These concentrations are many orders of magnitude higher than those found more than a few meters or feet from the discharge point. Offshore discharges of drilling mud dilute to near background levels within 1,000 m (3,281 ft) of the discharge point and would have a negligible cumulative effect on fisheries.

Produced-water discharges contain components and properties detrimental to commercial fishery resources. Offshore discharges of produced water also disperses and dilutes to near background levels within 1,000 m (3,281 ft) of the discharge point and have a negligible cumulative effect on fisheries. Offshore live bottoms would not be impacted. Offshore discharges and subsequent changes to marine water quality are regulated by U.S. Environmental Protection Agency NPDES permits.

Methylmercury is the bioavailable form of mercury. Biomagnification in large fish of higher trophic levels is a problem in the Gulf of Mexico. The bioavailability and any association with trace concentrations of mercury in discharged drilling mud has not been demonstrated. Numerous studies have concluded that platforms do not contribute to higher mercury levels in marine organisms. Recent data suggest that mercury in sediment from drilling platforms is not in a bioavailable form. Sampling results of methylmercury in the vicinity of OCS structures does not vary significantly from background concentrations.

The input of drilling mud and produced waters are limited and are diluted very quickly in the marine environment. Their environmental effects are, therefore, expected to be limited.

Summary and Conclusion

Activities resulting from the OCS Program and non-OCS events have the potential to cause limited detrimental effects to commercial fishing, landings and the value of those landings. The impact-producing factors of the cumulative scenario that are expected to substantially affect commercial fishing include commercial and fishing techniques or practices, hurricanes, installation of production platforms and underwater OCS obstructions, production platform removals, seismic surveys, petroleum spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling mud and produced waters.

Recent substantial impacts occurred because of the 2005 and 2008 hurricanes. At the estimated level of cumulative impact, the resultant influence on commercial fishing, landings, and the value of those landings is expected to be substantial and easily distinguished from effects due to natural population variations. The effects of impact-producing factors (e.g., installation of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling mud and produced waters) related to the WPA proposed action are expected to be negligible and indiscernible from natural fishery population variability. This is because the installation of production platforms and underwater OCS obstructions in the area is a relatively small footprint, the number of platform removals is small, seismic surveys are temporary, oil spills are vernally small scale, blowouts have a small probability, and trenching and discharges are highly regulated. The impacts of a catastrophic oil spill, such as the DWH event recently experienced in the Gulf of Mexico, based on limited data are discussed in **Appendix B**. Compared with non-OCS activities (such as commercial fishing practices, wetland loss, and hurricanes), the incremental effect of the proposed action is not expected to be significant.

4.1.1.15. Recreational Fishing

The BOEMRE has reexamined the analysis for recreational fishing presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below and in consideration of the DWH event. While the DWH event had some impacts on recreational fishing activity, the fact that the spill was a low-probability event leads the conclusions reached in the Multisale EIS and the 2009-2012 Supplemental EIS to be largely unchanged. Namely, the WPA proposed action could cause minor space-use conflicts and could have minor effects on fish populations that support recreational fishing activity. However, routine OCS activities can also enhance recreational fishing opportunities since oil platforms serve as artificial reefs for fish habitats. Small to medium spills are unlikely to significantly impact recreational fishing activity due to the short-term duration of their impacts and due to the likely availability of substitute fishing sites in a particular region. A large spill such as the DWH event can have more noticeable impacts to recreational fishing activity, as well as to individuals and firms that depend on angler spending. However, these effects can be mitigated to some extent through financial compensation and through policies of Federal and State fisheries management agencies. The WPA proposed action should not have large effects on recreational fishing activity since it does not significantly increase the likelihood of an additional spill along the lines of the DWH event.

4.1.1.15.1. Description of the Affected Environment

A detailed description of recreational fishing can be found in Chapter 3.3.2 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.14.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the description of recreational fishing incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

This section discusses the baseline environment for recreational fishing along the coast of Texas since this is the area most directly affected by the proposed WPA lease sale. Data on effort and catch levels for the most often fished species are first discussed. This is followed by a description of the interaction between recreational fishing activity and the broader economy of the region. Finally, a brief discussion of the potential impacts of the DWH event on the WPA is presented; however, the majority of the impacts of the spill were felt in the CPA and in Florida.

Catch and Effort Data

Recreational fishing data for Texas is collected by the Texas Parks and Wildlife Department. The NMFS, which provides recreational fishing data for most other states in the United States, does not report data for Texas. Panel A of **Table 4-8** presents data on the most commonly landed species in Texas waters in 2007, 2008, and 2009. Spotted seatrout accounted for the largest number of landings in all years; there were approximately 810,000 landings in 2009. Red drum was the second most landed species, followed by Atlantic croaker, sand seatrout, and black drum. Catch rates for most species have not exhibited a strongly upward or downward trend in recent years; however, landings of black drum have increased gradually over the past 3 years, while landings of red snapper have gradually decreased.

Panels B, C, and D of **Table 4-8** present data on fishing in inshore bays, State waters, and the EEZ of the Texas coast. As can be seen, the vast majority of fishing activity in Texas occurs in the extensive bay systems off the coast of Texas. This is particularly true for spotted seatrout, red drum, Atlantic croaker, and sand seatrout. Data on catch rates of particular species for particular Texas bays can be accessed on the Texas Parks and Wildlife Department's website (Texas Parks and Wildlife Department, 2010a). Red snapper and king mackerel are more often caught in State waters or in the EEZ; there are also moderate levels of spotted seatrout catch in both areas.

Table 4-9 presents data on the number of angler trips by geographic area and by whether private boats or charter boats were used. This table demonstrates that bay fishing comprises the vast majority of angler trips off the coast of Texas, accounting for 94 percent of recreational fishing activity. Private boating accounts for 88 percent of angler trips, while charter boating accounts for 12 percent. Fishing in State waters accounted for slightly more trips than in the EEZ. In addition, fishing trips in the EEZ were somewhat more likely to use charter boats than were trips in State waters.

Economic Effects of the Recreational Fishing Industry

Recreational fishing activity can affect a regional economy in a number of ways. Most directly, anglers affect the economy through spending on fishing-related goods and services. This direct spending includes both trip expenditures and expenditures on durable equipment. Trip expenditures include such things as transportation costs, boat fees, and bait expenses. Durable purchases include spending on things such as fishing equipment and fishing boats. **Table 4-10** presents data on total direct spending by anglers in each state along the Gulf of Mexico. Anglers in Texas spent $2.6 billion in 2008; this spending level was similar in scale to spending by anglers in Louisiana.

Direct spending by fishermen also supports firms in related industries along an economy's supply chain. In addition, spending by fishermen serves as income to other actors in an economy, which supports overall spending patterns. The NMFS conducted an economic analysis that attempted to quantify this dependence of the regional economy on recreational fishing activity (USDOC, NMFS, 2010e); this analysis utilizes many of the techniques of an earlier study by Gentner and Steinbeck (2008). These studies utilize input-output economic models, which create multipliers that can be used to predict levels of sales, value added, and jobs that result from direct spending on recreational fishing. Total sales refers to the sum of all transactions that occur due to direct spending, while value added refers to the sum of the additional production that occurs at each step along a supply chain. As can be seen in **Table 4-10**, the $2.6 billion in direct sales resulted in $3.3 billion in total sales activity and $1.6 billion in value added in Texas. This spending also helped to support over 25,000 jobs in the region.

Deepwater Horizon Event

The majority of the impacts of the DWH event were felt in the Gulf waters east of Texas. However, the recreational fishing industry in Texas will be affected to the extent that the fish ecology in the Gulf of Mexico changes due to the spill; **Chapter 4.1.1.13** provides more information regarding the effects of the DWH event on fish habitats. In addition, there could have been substitution of fishing activity away from the CPA towards Texas as a result of the spill. Conversely, some fishermen may have cancelled fishing trips in Texas due to concerns regarding the safety of the fish in the WPA. The Texas Parks and Wildlife Department produces seasonal recreational fishing data that can provide overall measures of the scale of some of these effects (Fisher, official communication, 2011). Namely, the Texas Parks and Wildlife Department has historically divided its data collection into two seasons: low season (November 21 through May 14) and high season (May 15 through November 20). Since the DWH event occurred at the very end of the low season, the data for the May 15 through November 20 period in 2010 should provide an overall sense of the extent to which recreational fishing activity was impacted in the immediate aftermath of the spill.

Table 4-11 presents landings data for the most often caught species in Texas during each season in 2009 and 2010. Panel A presents the overall catch data in Texas, while Panels B, C, and D present the catch data for Texas bays, State waters, and Federal waters. As can be seen in Panel A, the DWH event did not drastically change the overall number of landings for most species. This is likely because the vast majority of recreational fishing activity in Texas occurs in nearshore bays, which were quite distant from the *Deepwater Horizon* site. Indeed, species such as red drum, black drum, Atlantic croaker, and sand seatrout had a somewhat higher number of landings during the second season of 2010 compared with the same period in 2009. However, species such as king mackerel and red snapper, which are typically caught in State and Federal waters, did experience a decrease in landings. **Table 4-12** presents data on angler trips in each of the two seasons in 2009 and 2010. Overall, angler trips in Texas during the May through November period fell slightly from approximately 712,000 trips in 2009 to 702,000 trips during 2010. This decrease in overall angler trips was due to a decrease in fishing trips in State and Federal waters. However, the number of fishing trips in nearshore bays slightly increased from 656,000 to 661,000. Thus, as of yet, it does not appear that the DWH event has drastically changed the level of recreational fishing activity in Texas. However, BOEMRE will continue to monitor fishing activity in Texas and will update its baseline estimates as new information becomes available.

4.1.1.15.2. Impacts of Routine Events

Background/Introduction

A detailed description of the impacts of routine events on recreational fishing can be found in Chapter 4.2.1.1.10 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.13.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the description of recreational fishing incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Many of the species fished by recreational anglers are the same as those caught by commercial fishermen; one exception is menhaden, which is primarily a commercial species. The effects of routine OCS activities on commercial fishing are discussed in **Chapter 4.1.1.14.2**. Routine OCS actions can cause some minor disturbances to the fish populations that support recreational fishing activity. For example, OCS activity could cause coastal environmental degradation either through effects on water quality or on wetland habitat. The effects of routine OCS actions on fish resources and essential fish habitat are discussed in more detail in **Chapter 4.1.1.13**. In addition, construction operations and vessel traffic could cause some degree of space-use conflict with recreational fishing vessels. However, these impacts are likely to be short lived and small in scale.

A unique manner in which OCS actions can increase recreational fishing activity is through the role of oil platforms as artificial reefs. Indeed, oil platforms often attract a large fish population due to their particular suitability as reef structures. The Atlantic and Gulf States Marine Fisheries Commissions provide a guidebook that compares the relative suitability of various materials for use as artificial reefs (Atlantic and Gulf States Marine Fisheries Commissions, 2004). Hiett and Milon (2002) estimate that over 20 percent of all recreational fishing activity in the Gulf of Mexico occurs within 300 ft (91 m) of an oil and gas structure. The role of oil rigs as artificial reefs becomes a particularly important issue during the decommissioning stage. Namely, the removal of an oil rig from a particular site has the potential to damage the fish assemblages that often develop on an oil rig, which would also affect recreational fishing activity in a particular area. However, the owner of an oil rig has the option to participate in the "rigs-to-reefs" program of the appropriate State. These programs allow for portions of oil platforms to remain in the water as reefs after the productive life of a platform has ended. Platforms that are a part of these programs are either toppled in place or moved to a location that is a suitable fish habitat. Rigs-to-reefs programs are discussed in more detail in Appendix A.4 of the Multisale EIS. The U.S. policy towards artificial reef creation is outlined in the *National Artificial Reef Plan: Guidelines for Siting, Construction, Development, and Assessment of Artificial Reefs* (USDOC, NOAA, 2007). This Agency's policy regarding rigs-to-reefs programs is outlined in *Rigs-to-Reefs Policy, Progress, and Perspective* (Dauterive, 2000) and was updated in *Rigs to Reefs Policy Addendum: Enhanced Reviewing and Approval Guidelines in Response to the Post-Hurricane Katrina Regulatory Environment* (USDOI, MMS, 2009d) in light of Hurricane Katrina.

Proposed Action Analysis

The WPA proposed action would lead to 26-41 oil and gas production structures. This could lead to minor space-use conflicts with recreational fishermen, primarily during the construction phase. The proposed action could also lead to some forms of environmental degradation that could affect fish populations, which would also impact recreational fishing activity; these effects are discussed in more detail in **Chapter 4.1.1.13.2**. However, these effects are expected to be minimal, particularly given the small scale of the proposed action relative to the existing OCS oil and gas program.

The extent to which the proposed oil platforms would support recreational fishing activity would depend on their location. For example, oil rigs very far offshore are less likely to support recreational fishing activity. In addition, the extent to which a rig would serve as an attractor to fish would depend on the fish populations in nearby areas. Essential fish habitat maps of the Gulf of Mexico can be found on the Internet website of the Galveston Laboratory of NOAA Fisheries Service. The Texas Parks and Wildlife Department has an interactive mapping application that displays the locations of the oil platforms off the coast of Texas that have been converted to artificial reefs (Texas Parks and Wildlife Department, 2010b).

Summary and Conclusion

There could be minor and short-term, space-use conflicts with recreational fishermen during the initial phases of the WPA proposed action. The proposed action could also lead to low-level environmental degradation of fish habitat (these are discussed in **Chapter 4.1.1.13.2**), which would negatively impact recreational fishing activity. However, these minor negative effects would likely be outweighed by the beneficial role that oil rigs serve as artificial reefs for fish populations. Each structure placed during the WPA proposed action has the potential to function as a *de facto* artificial reef. The degree to which oil platforms will become a part of a particular State's rigs-to-reefs program will be an important determinant of the degree to which the proposed action would impact recreational fishing activity in the long term.

4.1.1.15.3. Impacts of Accidental Events

Background/Introduction

A detailed description of the impacts of accidental events on recreational fishing can be found in Chapter 3.3.3 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.14 of the 2009-2012 Supplemental EIS. The following information is a summary of the description of recreational fishing incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The most direct manner in which oil spills and other accidental events would impact recreational fishing activity would be through their effects on fish habitats in the area impacted by the spill. A spill could either contaminate fish in the immediate area or cause fish to move during the duration of the spill. A spill would likely cause more direct harm to larvae and eggs than adults, which could affect recreational fishing in the longer term. The effects of accidental events on essential fish habitats are discussed in **Chapter 4.1.1.13.3**. The fish species most important to recreational fishing in certain regions are discussed in **Chapter 4.1.1.15.1**. A number of these species are similar to the species that are important to the commercial fishing industry; the effects of accidental effects on commercial fishing are described in **Chapter 4.1.1.14.3**. The majority of recreational fishing in the Gulf of Mexico occurs in the bays and wetlands areas along the Gulf Coast; the impacts of accidental events on wetland areas are described in **Chapter 4.1.1.4.3**.

The effects of an oil spill on recreational fishing are different from those experienced by the commercial fishing industry in several ways. Most directly, the benefits received by anglers from fishing activity are determined by subtle issues such as the enjoyment of the fishing process and the aesthetics of a particular fishing site. As a result, the damage of an oil spill to recreational fishing will be determined by issues such as the availability of substitute fishing sites in a region and the additional costs of attending alternate sites. These effects are most often analyzed using a variety of mathematical modeling techniques; an overview of these techniques is presented by NRC (2006) and the European Inland Fisheries Advisory Commission (2010). Haab et al. (2000 and 2010) and Greene et al. (1997) are examples of applications of these methods to fisheries in the Gulf of Mexico. The *Exxon Valdez* spill was an example of a spill that occurred in an area with a large recreational fishing industry. Carson and Hanemann (1992) provide an economic analysis of the direct recreational fishing losses due to the *Exxon Valdez* spill; Mills (1992) provides a more descriptive analysis of the evolution of recreational fishing activity following the spill.

Any disruption to recreational fishing activity would also have broader economic implications to a particular geographic region. Disruptions to recreational fishing would affect boat launches, bait shops, and durable fishing equipment manufacturers. Gentner Consulting Group (2010) attempts to quantify the potential losses to State economies due to recreational fishing closures in light of the DWH event. This study uses the expenditure estimates and the input-output modeling framework of Gentner and Steinbeck (2008) to derive a daily measure of the potential losses in the economy due to fishing closures in the Gulf of Mexico. This study estimates that the recreational fishing industry contributes $9.8 million in direct expenditures, $23 million in total sales, and 183 jobs per day to the economy of the Gulf of Mexico. One can estimate the cost of a spill by restricting these estimates to a particular region and then multiplying the daily estimates by the total duration of a fishing closure brought about by an oil spill. It is also possible that an oil spill's effects on the recreational fishing industry could have broader effects on tourism. Namely, the loss of recreational fishing options at certain locations could dissuade visitors from taking trips to an overall area. Similarly, recreational fishing may suffer in areas not directly affected by oil due to uncertainty or to misperceptions regarding the extent of the oil damage. While these effects are difficult to quantify, the U.S. House of Representatives (2010) provides a descriptive overview of the tourism effects felt during the DWH event.

Proposed Action Analysis

Proposed WPA Lease Sale 218 would result in 39-65 producing oil wells, 83-127 producing gas wells, and 26-41 installed production platforms (**Table 3-2**). A spill at one of these sites would likely lead to recreational fishing closures in the immediate vicinity in the short term. Since oil rigs often are habitats for certain fish species, there could be noticeable impacts to the fish ecosystem in the area of the spill. In general, oil spills that are closer to shore would have greater impacts on recreational fishing activity. As can be seen in **Table 4-8**, spotted seatrout, red drum, Atlantic croaker, and sand seatrout are the species most likely to be affected by a spill reaching the Texas coast. A spill farther from shore would primarily affect species such as red snapper and king mackerel.. Maps of fish habitats in the Gulf of Mexico that could be impacted by an oil spill can be found on the Internet website of the Galveston Laboratory of NOAA Fisheries Service and on NOAA's ERMA website (USDOC, NOAA, 2010j). The Texas Parks and Wildlife Department also provides catch data for any individual fishing bay along Texas's Gulf Coast.

Summary and Conclusion

An oil spill would likely lead to recreational fishing closures in the vicinity of the oil spill. Small-scale spills should not affect recreational fishing to a large degree due to the likely availability of substitute fishing sites in neighboring regions. A rare large spill such as the one associated with the DWH event can have more noticeable effects because of the larger potential closure regions and because of the wider economic implications such closures can have. However, the longer-term implications of a large oil spill would primarily depend on the extent to which fish ecosystems recover after the spill has been cleaned. Because offshore spills have a small probability of contacting estuarine habitats that serve as nurseries for many recreational species and because inshore spills would have localized impacts to an area, oil spills would have a small effect on recreational fisheries.

4.1.1.15.4. Cumulative Impacts

Background/Introduction

A detailed description of the cumulative impacts to recreational fishing can be found in Chapter 4.5.12 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.14 of the 2009-2012 Supplemental EIS. The following information is a summary of the description of recreational fishing incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The cumulative impacts to recreational fishing activity from the WPA proposed action would arise from the existing 5-Year Program and from the expected progression of the recreational fishing industry in the Gulf of Mexico. These impacts would arise from the cumulative effects on fish resources in the Gulf of Mexico, which are discussed in **Chapter 4.1.1.13.4**. This chapter discusses the cumulative impacts of wetland loss, marine/estuary water quality degradation, damage to live bottoms, structure removals, petroleum spills, subsurface blowouts, pipeline trenching, and discharges of drilling mud and processed waters on fish resources. Because many of the recreationally sought fishes are also harvested commercially, a number of the cumulative impacts to the recreational fishing industry are similar to those of the commercial fishing industry. This is true even though recreational fishing is primarily confined to smaller, closer inshore areas of the Gulf of Mexico than commercial fishing. **Chapter 4.1.1.14.4** outlines the cumulative impacts of commercial fishing practices, hurricanes, installation of production and underwater obstructions, platform removals, seismic surveys, petroleum spills, subsurface blowouts, pipeline trenching, and the offshore discharge of drilling mud and produced waters on commercial fishing. The cumulative impacts unique to recreational fishing activity would arise from State and Federal fisheries management plans, the role of oil platforms as artificial reefs, and the lingering impacts of the DWH event.

State and Federal Fisheries Management Plans

Proposed WPA Lease Sale 218 could have cumulative impacts to the extent to which it alters or interacts with State and Federal Fisheries Management Plans. Recreational fishing activity is highly regulated, primarily to ensure a sustainable fisheries population through time. This often takes the form of catch limits per trip and quotas for overall catch per species during a given season. Recreational fishing activity in Federal waters is governed by the Gulf of Mexico Fishery Management Council (GMFMC); their most recent policies are outlined in *Recreational Fishing Regulations for Gulf of Mexico Federal Water* (GMFMC, 2011). Each State has its own guidelines for recreational fishing in State waters. Texas's fisheries management policies can be accessed on the Internet website of the Texas Parks and Wildlife Department (2010c); Federal Fisheries Management Plans could exacerbate the impacts of OCS actions if both were to impact certain species or fishing sites. However, fisheries management plans could also serve to mitigate the effects of an oil spill since these plans are often designed to maintain stable fishing activity. For example, the GMFMC allowed for a supplemental red snapper season in October 2010 since red snapper catch was unusually low during the DWH event (GMFMC, 2010b). This supplemental red snapper season was designed to allow the 2010 quota for red snapper catch to be reached.

Rigs-to-Reefs and Artificial Reef Development

Oil and gas platforms constructed as a result of the WPA proposed action would contribute to the important role that OCS platforms serve as artificial reefs for fish habitats. Platforms often attract a large fish population due to their particular suitability as reef structures. Hiett and Milon (2002) estimate that over 20 percent of all recreational fishing activity in the Gulf of Mexico occurs within 300 ft (91 m) of an oil and gas structure. The role of oil rigs as artificial reefs becomes a particularly important issue during the decommissioning stage. Namely, the removal of an oil rig from a particular site has the potential to damage the fish assemblages that often develop at an oil rig, which would also affect recreational fishing activity in the area. However, the owner of an oil rig has the option to participate in the "rigs-to-reefs" program of the appropriate State. These programs allow for portions of oil platforms to remain in the water as reefs after the productive life of a platform has ended. Platforms that are a part of these programs are either toppled in place or moved to a location that is a suitable fish habitat. Rigs-to-reefs programs are discussed in more detail in Appendix A.4 of the Multisale EIS. The U.S. policy towards artificial reef creation is outlined in the *National Artificial Reef Plan: Guidelines for Siting, Construction, Development, and Assessment of Artificial Reefs* (USDOC, NOAA, 2007). This Agency's policy regarding rigs-to-reefs programs is outlined in *Rigs-to-Reefs Policy, Progress, and Perspective* (Dauterive, 2000) and was updated in *Rigs to Reefs Policy Addendum: Enhanced Reviewing and Approval Guidelines in Response to the Post-Hurricane Katrina Regulatory Environment* (USDOI, MMS, 2009d) in light of Hurricane Katrina. Maps of artificial reef locations in Texas can be accessed at through an interactive mapping tool provided by the Texas Parks and Wildlife Department (2010c).

Deepwater Horizon *Event*

The DWH event may heighten the sensitivity of recreational fishing activity in the WPA to additional oil spills that may occur over the next several years. This is partly due to the fact that fish populations are still responding to the spill, the ultimate, long-term outcome of which is not yet clear. This is also due to the complex manner in which recreational fishing activity and tourism interact. Namely, recreational fishing activity is one of a number of factors that draw tourists to a particular region. The high level of national attention focused on the DWH event suggests that future oil spills, even if smaller in scale, could raise greater concerns regarding recreational fishing in affected areas among tourists. While this effect may be offset by additional fishing by others, any decrease in fishing based tourism could have broader impacts to a local economy. However, since the majority of the impacts of the DWH event were felt in the CPA and in Florida, these lingering effects are more likely to be felt in those areas.

Summary and Conclusion

The WPA proposed action and the broader OCS Program have varied effects on recreational fishing activity. The OCS Program has generally enhanced recreational fishing opportunities due to the role of oil platforms as artificial reefs. This effect depends importantly on the extent to which rigs are removed at decommissioning or are maintained through "rigs-to-reefs" programs. However, oil spills can have important negative consequences on recreational fishing activity due to the resultant fishing closures and longer-term effects oil spills can have on fish populations. This was evident during the DWH event, the effects of which are not yet certain. However, this type of catastrophic spill event is rare. The contribution of proposed WPA Lease Sale 218 to these positive and negative cumulative effects would be minimal because of the relatively small amount of activity expected with the proposed action. It is likely that Fisheries Management Plans of the Federal and State governments would serve to keep overall recreational fishing activity reasonably stable through time.

4.1.1.16. Recreational Resources

The BOEMRE has reexamined the analysis for recreational resources presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below and in consideration of the DWH event. The DWH event primarily affected the CPA and Florida and thus has not significantly changed the baseline environment for recreational resources in Texas. In addition, the fact that the spill was a low-probability event leads the impact conclusions for recreational resources to be similar to those reached in the Multisale EIS and the 2009-2012 Supplemental EIS. Namely, routine OCS actions can lead to low levels of space-use conflict and can cause some minor aesthetic impacts. Oil spills will have short-term impacts to beaches and to local economies that depend on beach recreation. The DWH event also highlighted the fact that a catastrophic spill can have complex effects on tourism activity in a broader economic area. However, the overall impacts of proposed WPA Lease Sale 218 are expected to be minimal since the proposed lease sale does not significantly increase the likelihood of a large oil spill.

4.1.1.16.1. Description of the Affected Environment

A detailed description of recreational resources can be found in Chapter 3.3.3 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.14 of the 2009-2012 Supplemental EIS. The following information is a summary of the description of recreational resources incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The coastal region of the Gulf of Mexico supports a broad range of recreational activities, including beach visitation, marine fishing, and nature-based recreation. These recreational opportunities attract visitors from around the world to the region. As such, these recreational resources are integral components to the broader economy of the Gulf of Mexico, supporting activities such as restaurants, lodging, and transportation. This section discusses the baseline conditions for recreational resources along the coast of Texas since this is the primary region that could be impacted by proposed WPA Lease Sale 218. The economic significance of the recreation and tourism industries in the coastal zone of Texas is presented first; this is followed by a more in-depth discussion of the recreational industry in Texas. A brief discussion of the DWH event is also presented; however, the majority of the impacts of the spill were felt in the CPA and in Florida.

Economic Significance of the Recreational Industry in the Gulf Coast

The recreation and tourism industries are major sources of employment along the Gulf Coast. **Table 4-13** presents employment statistics for a set of geographic regions in the Gulf of Mexico. Panel A presents data on the number of employees in the leisure/hospitality industry from 2001 through 2009 in 13 BOEMRE-defined Economic Impact Areas (EIA's); these regions are defined in **Figure 2-2** (All employment data were obtained through the U.S. Dept. of Labor, Bureau of Labor Statistics.). In **Table 4-13**, the leisure/hospitality industry corresponds to the definition used by the North American Industrial Classification System; this definition includes sub-industries such as entertainment providers, lodging services, and food/beverage services. Panel A shows that approximately 310,000 people worked in the leisure/hospitality industry in the Texas EIA's in 2009. TX-3, which includes the Houston and Galveston areas, has by far the largest recreational industry with approximately 240,000 workers in 2009. TX-1, which includes the areas around South Padre Island and Corpus Christi, has approximately 53,000 recreation workers. TX-2 has around 16,000 recreations workers, primarily driven by the recreational resources in Brazoria and along Matagorda Bay. Recreational employment in all three EIA's exhibited steady growth from 2001 through 2007; employment in these regions generally fell in 2008 and 2009 with the onset of the global economic downturn during that time. Hurricane Ike, which hit the Texas coast in September 2008, caused a good deal of damage to the Galveston Island region. Recreational employment in Galveston County fell from 14,200 in December 2007 to 12,500 in December 2008; employment had recovered to a level of 13,610 by December 2009 (U.S. Dept. of Labor, Bureau of Labor Statistics, 2010a).

Panel B of **Table 4-13** presents the number of employees in recreation/tourism in the EIA counties/parishes that are directly along the Gulf Coast. These counties/parishes are particularly vulnerable to the effects of an oil spill such as the DWH event. Recreational employment in coastal counties in Texas is noticeably lower than in EIA's; this is primarily due to the fact that Harris County, home to Houston, does not border the Gulf of Mexico. Panel C of **Table 4-13** presents data on the total number of jobs in the recreation and tourism industries in each state; Texas EIA counties account for approximately one-third of the recreational employment in Texas. **Table 4-14** presents data on total wages earned in the leisure/hospitality industry for the same geographic regions discussed in **Table 4-13**. In 2009, recreation workers in Texas EIA counties earned approximately $5.6 billion, which is second only to Florida among the Gulf Coast States. Wages in Texas did not fall in 2008 and 2009 along with the slight fall in employment, although the growth in total wages slowed to some extent. It is worth noting that lower than average wages, particularly in TX-1 and TX-2, caused Texas total wages to represent a somewhat smaller fraction of total Gulf Coast wages than of Gulf Coast employment (the average salary of workers can be closely approximated by dividing total wages by total employment in any geographic region).

Table 4-15 presents data on total tourism spending in each of the Gulf States (U.S. Travel Association, 2010). This is a somewhat different perspective than the wage data of **Table 4-14**. Total spending is higher than total wages since only a fraction of tourism spending translates into wages. For example, a portion of spending ends up as profit to the owners of the enterprises. In addition, spending on some items, particularly manufactured goods, may translate into wages to workers that are not categorized as being in the leisure/hospitality industry. Thus, looking at total spending provides a broader measure of the impact of tourism on the economies of the Gulf States. However, it is important to note that the data in **Table 4-15** focuses only on spending by visitors and ignores spending on recreational activity by local residents. Therefore, the total economic impact of the recreation/tourism industry is somewhat greater than the data shows.

Table 4-15 shows that visitors to Texas spent approximately $51 million in 2008. Tourism spending in Texas has generally been rising since 2002; indeed, Texas has experienced more rapid growth in its tourism industry than most other Gulf Coast States in recent years.

A final perspective from which to view aggregate employment data is provided by Kaplan and Whitman (unpublished). This paper attempts to isolate those jobs that are particularly sensitive to OCS activities. For example, ocean and beach recreational activities are likely to be more sensitive to OCS activities, particularly in the event of an oil spill, than would recreational activities far inland. This is particularly true for some of the resources along the vast barrier island system along the coast of Texas. However, a large portion of the jobs listed in **Table 4-13** occur in restaurants, gambling facilities, and a myriad of other types of recreational activities. While these types of activities can still be affected by OCS activities, these effects are less direct than for ocean-based tourism/recreation. Kaplan and Whitman (unpublished) attempt to account for this effect by weighting each recreational activity by the extent to which it applies to tourism activity, as well as the extent to which it is dependent on coastal resources.

Table 4-16 presents the estimated payroll, number of employees, and number of establishments associated with coastal travel, tourism, and recreation in 2004; there has not been a more recent study that uses an approach similar to Kaplan and Whitman. Kaplan and Whitman (unpublished) identify approximately 14,000 of these jobs in Texas that support a payroll of approximately $370 million. There is a fair amount of uncertainty in these numbers due to measurement issues and to events that have occurred since the measurement period, most notably hurricanes and the DWH event. However, it is still of use to provide a rough estimate of the most at risk jobs in a particular area since this can give a sense of the scale of the broader effects OCS activities can have on activities that indirectly depend on these workers. Indeed, one of the particularly important contributions of this study is to estimate the number of coastal travel, recreation, and tourism jobs on a county-by-county basis, which can guide policymakers when analyzing the effects of the DWH event and of future potential accidental events.

Another manner in which OCS activity can affect recreation is through the effects of oil and gas structures themselves. Namely, there is a substantial amount of recreational fishing and recreational diving activity associated with these structures in the Gulf of Mexico. Hiett and Milon (2002) estimated that roughly 22 percent of all fishing trips in the Gulf of Mexico were taken within 300 ft (91 m) of an oil or gas structure during 1999. This study also found that approximately 94 percent of recreational diving trips took place near an oil or gas structure. This study also estimated that these trips led to $13.2 million in diving expenditures and $159.7 million in recreational fishing expenditures. More information on the structure of the recreational fishing industry in Texas can be found in **Chapter 4.1.1.15**.

Recreational Resources on the Texas Gulf Coast

The Texas Gulf Coast is home to a diverse set of recreational resources that support a large recreational industry. Dean Runyan Associates (2010) estimates that tourists spent $14.5 billion on the Texas Gulf Coast in 2009. The Gulf Coast counties with the largest concentration of recreation workers (over 10,000 workers) in the Gulf Coast region of Texas are Hidalgo, Cameron, Nueces, Fort Bend, Galveston, Harris, and Jefferson (U.S. Dept. of Labor, Bureau of Labor Statistics, 2010a). Harris County has a particularly large concentration of approximately 175,000 workers. **Table 4-17** presents a detailed breakdown of tourism spending in Texas (Dean Runyan Associates, 2010). As can be seen, accommodation services, food services, and transportation services each accounted for over $2 billion in Gulf Coast recreation spending in 2009. Visitor retail sales accounted for about $1.7 billion, while direct spending on entertainment-related services accounted for approximately $1.4 billion.

The vast majority of tourism and recreation in the Texas Gulf Coast occurs in five Metropolitan Statistical Areas (MSA's): Brownsville/Harlingen, Corpus Christi, Victoria, Houston/Baytown/Sugar Land, and Beaumont/Port Arthur. **Table 4-18** presents information on the number of visitors and the level of visitor spending in each MSA; the number of visitors comes from D.K. Shifflet and Associates (2010a), while visitor spending comes from Dean Runyan Associates (2010). As can be seen, the Houston/Baytown/Sugarland region is by far the largest tourist destination on the Texas Gulf Coast, attracting approximately 30 million visitors and over $12 billion in visitor spending in 2009. This region includes Galveston Island, a major source of beach tourism; the two major beaches in Galveston are Stewart Beach and East Beach. Texas has 168 beaches in total (**Table 4-19**) that attract approximately 5 million visitors annually (USEPA, 2008c). Galveston Island is also home to Moody Gardens, an entertainment park that includes a vast array of nature-based recreational opportunities. Galveston Island was the area most directly impacted by Hurricane Ike's landing in September 2008. Hurricane Ike damaged some recreational resources, including Galveston Island State Park (Texas Parks and Wildlife Department, 2010d). Galveston tourism as a whole, however, seems to be recovering reasonably well from the storm. For example, in Summer 2010, hotel tax receipts in Galveston increased by 20 percent in May, 34 percent in June, and 32 percent in July, compared with receipts in Summer 2009; this left hotel receipts only about 15 percent below receipts in Summer 2008 (Galveston.com, 2010).

Corpus Christi Bay is the second largest recreational area on the Texas Gulf Coast, attracting over 6 million visitors and over $1 billion in spending annually. Some of the main attractions of the Corpus Christi area include the Texas State Aquarium and the USS *Lexington* Museum; estimates of the number of visitors to these and other recreation sites in Texas can be found in D.K. Shifflet and Associates (2010b). Mustang Beach and Mustang Island State Park are located in the barrier island system directly off the coast of Corpus Christi Bay. The Padre Island National Seashore is located in the barrier island system south of Mustang Island; The Padre Island National Seashore is a vast stretch of largely undeveloped land that is home to a wide variety of birding and fishing opportunities. The Corpus Christi area is at the center of a vast system of birding trails in Texas; more information can found through the Texas and Parks and Wildlife Department. Nature watching is also a particularly important component of the economy of Texas, attracting 2.9 million in spending annually (USDOI, FWS and USDOC, U.S. Census Bureau, 2006).

South Padre Island, located on the southernmost coast of Texas near Harlingen, is one of the major beach recreation areas on the Gulf Coast and is a driver of much of the local economy. The recreation economies of Victoria MSA and Beaumont/Port Arthur MSA are primarily driven by some of the parks and national wildlife refuges in or near these regions; examples of these include Aransas National Wildlife Refuge, Matagorda Island State Park, San Bernard National Wildlife Refuge, Brazoria National Wildlife Refuge, Anahuac National Wildlife Refuge, McFaddin National Wildlife Refuge, and Big Thicket National Preserve. Estimates of the economic significance of some of these areas can be found in Kaplan and Whitman (unpublished); the geographic location of these areas can be found using NOAA's ERMA mapping system (USDOC, NOAA, 2010j).

Deepwater Horizon Event

The WPA was largely unaffected by the DWH event, as the vast majority of the spilled oil stayed off the coast of Louisiana and other eastern Gulf States. The Macondo well was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). While there were scattered reports of a small number of tarballs reaching areas such as Galveston Island (under the theory that they formed from oil transported into the WPA by vessels) (RestoreTheGulf.gov, 2010a), the findings were of such a small scale that significant direct impacts on tourism are unlikely. The DWH event and resulting oil spill primarily caused indirect impacts in Texas that appear to be fairly small in scale. For example, some tourists may have stayed away from Texas Gulf Coast beaches due to misperceptions regarding the extent to which these beaches were damaged due to the spill. Conversely, there may have been some substitution of beach visitation away from beaches in the eastern Gulf towards the beaches in Texas, which were farther from the spill. While it is difficult to quantify these effects, some anecdotal evidence regarding this substitution effect can be found in Pack (2010). Hotel occupancy data suggest that these two effects may have largely offset each other. Source Strategies Inc. (2010) reports that total hotel occupancy in the three metro regions closest to the Gulf Coast increased just 1.9 percent during the third quarter of 2010 compared with the third quarter of 2009. Damage claims data also suggest that the effects of the DWH event on the Texas recreational industry were relatively small in scale. **Table 4-20** presents data on the amount of damages paid to individuals and businesses by the Gulf Coast Claims Facility in different industries (Gulf Coast Claims Facility, 2011). As of April 9, 2010, $27.8 million had been paid to individuals and $90.9 million had been paid to businesses in Texas. This represents a small fraction of the approximately $3.8 billion in damage payments that have been paid throughout the Gulf Coast. Claims in Texas were primarily concentrated in the fishing; seafood processing and distribution; retail sales and service; and food, beverage, and lodging industries. Direct claims in the tourism/recreation industry were only $160,000, although some of the indirect impacts felt by other industries were tourism related.

Employment and wage data also do not suggest significant structural change in the recreational industry in Texas as a result of the DWH event. **Table 4-21** presents monthly data on total employment in the leisure/hospitality industry during 2010. These data are presented for the same geographic regions as in **Table 4-13**; all employment and wage data were obtained through the U.S. Bureau of Labor Statistics. The definition of the leisure/hospitality industry corresponds to the definition used by the North American Industrial Classification System; this definition includes sub-industries such as entertainment providers, lodging services, and food/beverage services. As can be seen, employment remained relatively stable in each of Texas' EIA's in the months following the DWH event. Namely, the combined employment in the leisure/hospitality industry in these EIA's increased 1.3 percent from March 2010 to September 2010. **Table 4-22** presents quarterly data on total wages earned by workers during 2009 and 2010 in the leisure/hospitality industry for the same geographic regions as were presented in **Table 4-21**. As can be seen, wages slightly increased in the third quarter of 2010 compared with the third quarter of 2009. Thus, the available economic data suggest that the structure of the recreational industry in Texas has not significantly changed following the DWH event. In addition, any minor fluctuations in employment and wages that did occur in localized areas are likely to be transitory since the physical recreational resources along the Texas coast were generally unharmed.

4.1.1.16.2. Impacts of Routine Events

Background/Introduction

Routine OCS oil and gas activities can affect recreation and tourism in diverse ways. The OCS activities can have direct negative impacts on beach and coastal recreational resources through discharges of marine debris, noise, and visual impairments. There are also possible indirect impacts on local recreational resources from space-use conflicts and from increased economic activity from OCS operations. The unique role that oil platforms can play as artificial reefs should also be accounted for when considering policy actions. However, while impacts on recreational resources from routine OCS activities can occur from a number of sources, in total they are likely to be reasonably small in scale.

Beaches and other coastal recreational resources are the most vulnerable to routine OCS operations. One concern is the extent to which discharges of marine debris from OCS actions could reach these areas. Debris can noticeably affect the aesthetic value of coastal areas, particularly beaches. This is particularly true given the significant levels of marine debris that already exist in some areas. Marine debris originates from OCS operations, sewage treatment plants, recreational and commercial fishing, industrial manufacturing, and various forms of vessel traffic. The United Nations Environment Programme (2009) presents a broad overview of the nature of the marine debris problem. Various government agencies participate in a coordinated effort to combat marine debris; a broad summary of the issues involved and the policy structure with respect to marine debris can be found in the report of the Interagency Marine Debris Coordinating Committee (USDOC, NOAA, 2008b). There is also a national monitoring program in place to track the progression of the marine debris problem in various locations. Sheavly (2007) describes the structure of the National Marine Debris Monitoring Program; Ocean Conservancy (2011) presents the results from the most recent round of debris monitoring. McIlgorm et al. (2009) presents an economic analysis of the costs of marine debris and of programs designed to minimize debris. Finally, Barnea et al. (2009) outlines some issues regarding debris removal that are unique to the Gulf of Mexico.

The discharge of marine debris is subject to a number of laws and treaties. These include the Marine Debris Research, Prevention, and Reduction Act; the Marine Plastic Pollution Research and Control Act; and the MARPOL-Annex V Treaty. Regulation and enforcement of these laws is conducted by a number of agencies, such as USEPA, NOAA, and USCG. The BOEMRE policy regarding marine debris prevention is outlined in NTL 2007-G03, "Marine Trash and Debris Awareness and Elimination" (USDOI, MMS, 2007f). This NTL requires that OCS operators post informational placards that outline the legal consequences and potential ecological harms of discharging marine debris. This NTL also instructs OCS workers to complete annual marine debris prevention training, and operators are also instructed to develop a certification process for the completion of this training by their workers. These various laws, regulations, and NTL's will likely minimize the potential damage to recreational resources from the discharge of marine debris from OCS operations.

There are also potential negative impacts on beach tourism from vessel noise and from the visibility of OCS infrastructure. While the potential effects of noise on tourism are difficult to quantify, several characteristics of the OCS industry serve to minimize these effects. First, most OCS-related vessel traffic moves between onshore support bases and work and production areas far offshore. Support bases are located in industrial ports, which are usually distant from recreational use areas. Second, OCS vessel use of approved travel lanes should keep noise fairly transitory and thus unlikely to noticeably impact tourism. The extent to which the visibility of OCS platforms can affect tourism depends primarily on the distance of platforms from shore and on the size of the particular oil rig. For example, a study by the Mississippi Development Authority found that a 50-ft (15-m) high production platform was identifiable 3 mi (5 km) from shore and a 100-ft (30-m) high production platform was visible 10 mi (16 km) from shore (Collins Center for Public Policy, 2010). All OCS platforms are at least 3 mi (5 km) from shore and most are beyond 10 mi (km) from shore. Even if a platform were visible, the scale of its impact on tourism would likely be small unless it interrupted the vision of other important landscape features.

Oil platforms constructed along with OCS activities serve unique roles as artificial reefs. Soon after deployment, an oil platform attracts a wide variety of fish species and other organisms to its structure. As a result, some offshore platforms are important components to the recreational fishing industry; oil platforms are also hosts to a large amount of recreational diving activity (Hiett and Milon, 2002). The role of oil rigs as artificial reefs also raises a number of issues during the decommissioning stage of an oil platform's life. Each Gulf Coast State has a mechanism for allowing some oil platforms to remain in place and to continue to serve as artificial reefs after oil production has ceased; Dauterive (2000) provides an overview of these programs. McGinnis et al. (2001) also discuss the broader economic implications of decommissioning oil structures. This decommissioning stage has the potential to affect recreational resources in a particular area if a rig is ultimately not maintained for reef purposes or if the rig is moved to a different location. More information on the impacts of routine OCS actions on recreational fishing activity can be found in **Chapter 4.1.1.15.2**.

The OCS oil and gas activity can also affect recreational resources indirectly due to a number of economic factors. First, increased onshore infrastructure necessary to support offshore activities can create space-use conflicts. For example, Brody et al. (2006) present an analysis of space-use conflicts for oil and gas activities off the coast of Texas, although the issues they raise are generally applicable to OCS activities. They use a GIS-based framework to identify specific locations where conflicts between oil activities and other concerns (including recreational use) are most acute; they find that recreational use conflicts tend to be concentrated around some of the major wildlife viewing and beach areas near the larger population areas in Texas. In addition, the effects of OCS activities on the structure of employment in local economies has the potential to increase or decrease the demand for recreational resources in these communities. Increased demand for recreational resources has the potential to attract new recreational firms to a community; however, increased demand also has the potential to lessen the enjoyment of a particular resource by some community members. Mason (2010) provides some context on the interdependence of the offshore oil and gas industry with other sectors of the economy of the Gulf of Mexico; for example, they show that accommodation and food service resources have a reasonably high dependence on OCS activities. Wallace et al. (2001) also discuss community level effects of OCS activities on some of the local economies in the Gulf of Mexico; for example, this study presents descriptive evidence regarding concerns some local residents have regarding the impacts of OCS activities on recreational opportunities. However, given the limited scale of the proposed action relative to the existing oil and gas industry, the scale of the indirect economic impacts caused by new leasing activity is likely to be small.

Proposed Action Analysis

Proposed WPA Lease Sale 218 would result in 39-65 producing oil wells, 83-127 producing gas wells, and 26-41 installed production platforms. Marine debris would be lost from time to time from OCS operations associated with drilling activities projected to result from the WPA proposed action. Current industry waste management practices, training and awareness programs focused on the beach litter problem, and the OCS industry's continuing efforts to minimize, track, and control offshore wastes are expected to minimize the potential for accidental loss of solid wastes from OCS oil and gas operations.

Proposed WPA Lease Sale 218 is expected to result in 1,900-3,525 service-vessel trips and 10,000-22,500 helicopter operations annually. Service vessels are assumed to use established nearshore traffic lanes, and helicopters are assumed to comply with areal clearance restrictions at least 90 percent of the time. These actions tend to distance traffic from recreational beach users and thus minimize its effects. The additional helicopter and vessel traffic would add a low level of noise pollution that would affect beach users.

The broader economic implications of the proposed action would be felt primarily on the Gulf Coast of Texas. The Texas coastline features an important barrier island system that supports a broad range of beach-related activity. However, given the expansive oil and gas industry already in place, as well as the distance of oil platforms in Texas from shore, beach-related disruptions due to OCS operations are expected to be minimal. As discussed in **Chapter 4.1.1.18.3**, the EIA associated with the Houston region is likely to feel the most direct effects from any increase in employment associated with the proposed action. However, given the size of Houston's economy, relative to the proposed action, there is unlikely to be any noticeable crowding out of recreational resources in the region. Similarly, impacts of routine activities on property values and tourism are likely to be small since the proposed action does not substantially change the structure of OCS operations in the Gulf of Mexico.

Summary and Conclusion

Routine OCS actions in the WPA could cause minor disturbances to recreational resources, particularly beaches, through increased levels of noise, debris, and rig visibility. The proposed action would create more platforms to act as artificial reefs. Therefore, some impacts would be minor or could even be beneficial through the creation of new fish habitats and diving locations. The OCS activities could also change the composition of local economies through changes in employment, land-use, and recreation demand. Proposed WPA Lease Sale 218 has the potential to directly and indirectly impact recreational resources along the coast of Texas. However, the small scale of the proposed action relative to the scale of the existing oil and gas industry is such that these potential impacts on recreational resources are likely to be minimal.

4.1.1.16.3. Impacts of Accidental Events

Background/Introduction

A detailed description of the effects of accidental events on recreational resources can be found in Chapter 3.3.3 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.14 of the 2009-2012 Supplemental EIS. The following information is a summary of the description of recreational resources incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The recreational resources most vulnerable to an oil spill are beaches and nature parks along the Gulf Coast. Environmental Sensitivity Indexes (ESI's) provide overall measures of the sensitivity of a particular coastline to a potential oil spill (USDOC, NOAA, 2010k). The ESI's rank coastlines from 1 (least sensitive) to 10 (most sensitive); ESI maps also provide point indicators for recreational resources. Marshes and swamps are examples of resources that have ESI's of 10 due to the extreme difficulty of removing oil from these areas. The ESI's for beach areas generally range from 3 to 6, depending on the type of sand and the extent to which gravel is mixed into the beach area. The ESI maps for any coastline along the Gulf of Mexico can be viewed using NOAA's ERMA mapping system (USDOC, NOAA, 2010j).

The effects of an oil spill on a particular beach region would depend on the success of the containment and cleanup operations following an oil spill. A broad overview of the procedures used to assess oiled beaches is presented in NOAA's shoreline assessment manual (USDOC, NOAA, 2000). Both manual and machine-based techniques can be used to clean oil; the cleaning technique chosen for a particular beach would depend on the nature of the oiling of a particular beach area. The nature of cleanup operations will also depend on whether a particular beach serves as a habitat to particular animal species. This is because removing oil deep below a beach surface can sometimes do more ecological harm than good. As a result, ecological beaches are often only cleaned to a shallow depth, while nonecological ("amenity") beaches are often cleaned more extensively. The same is true around cultural and archaeological sites, such as shipwrecks embedded in the beach, where manual cleaning techniques may be dictated. The cleanup plan for any particular beach is determined by a Shoreline Treatment Recommendation, which is prepared by the relevant State and Federal agencies for a particular spill. An example Shoreline Treatment Recommendation following the DWH event for Grande Isle Island can be found at RestoreTheGulf (2010c). The Operational Science Advisory Team (2011) presents an overview of the cleanup operations during the *Deepwater Horizon* oil spill. This report also indicates the beach areas for which work is still progressing and those that have been cleaned to the extent prescribed by the relevant Shoreline Treatment Recommendation. Wang and Roberts (2010) discuss some concerns regarding the effects of remnant oil in certain areas on the long-term ecological and recreational uses of these areas.

Recreational resources such as beaches serve as important bases for certain local economies. Therefore, oiled beach regions can cause economic losses to both individuals and firms in the area of an oiled or closed beach. Parsons and Kang (2007) perform an economic analysis of the costs of hypothetical beach closures along the Texas Gulf Coast. They estimate that the economic costs of beach closures along the Padre Island National Seashore would range from $26,000 to $172,000, depending on the time of year the closures would occur. The oil spill off the Tampa Bay, Florida, coast in 1993 is an example of a spill that affected recreational beaches. Damage to these beaches and other recreational resources was determined to cause $2.5 million in damages to the affected parties in the area (Florida Dept. of Environmental Protection and USDOC, NOAA, 2000). Finally, the New Orleans oil spill of 2008 demonstrates that a spill can affect different types of recreational activities. Namely, this spill impacted some of the boating and restaurant businesses in the vicinity of the spill; it also caused some aesthetic impacts to the experiences of tourists in the region (Tuler et al, 2010).

The DWH event was much more significant in size and duration than the spills previously mentioned. As such, it raises important questions regarding the impacts of oil spills on recreation and tourism. One important point is that a spill of the DHW event's dimensions can influence a much broader range of individuals and firms than can a smaller spill. For example, a small, localized spill may lead some travelers to seek substitute recreational opportunities in nearby areas. However, a large spill is more likely to dissuade travelers from visiting a broader economic region. Similarly, mid-sized restaurant chains and hotels may be able to find other customers or to simply weather a smaller spill. However, a spill the size of the one that resulted from the DWH event is more likely to affect these types of firms since they are less able to diversify their customer base. These effects can be seen in the makeup of those who have filed damage claims with BP (Gulf Coast Claims Facility, 2010a). For example, the bulk of the claims by individuals have been made in the food, beverage, lodging sector and in the retail, sales, and service sector. Claims have also been made by individuals and firms in a broad range of geographic regions, many of which were not directly impacted by oil. The claims process and the cleanup process must also be taken into account when attempting to ascertain the ultimate impacts of a spill on a recreational economy. For example, Murtaugh (2010) found a noticeable increase in hotel receipts in coastal Louisiana and on the Mississippi/Alabama border during the summer of 2010 compared with the summer of 2009; this same study found that counties in the northwest corner of Florida experienced a noticeable decrease in receipts during the same time periods. While the spill caused economic damage to a number of people in the Louisiana and Mississippi/Alabama border area, this example demonstrates that the effects of cleanup and damage mitigation activities must be taken into account when analyzing the overall impact of a spill on recreational economies.

The broad impact of the DWH event also highlights the critical role of media coverage and public perceptions in determining the extent to which an oil spill would affect the recreational economy. Namely, there were a number of reports that various effects on tourism were felt in areas beyond the locations in which oil washed up along beaches and other areas. A Congressional hearing into this matter (U.S. House of Representatives, 2010) provides a broad overview of some of the effects that were felt along the Gulf Coast. For example, a representative of Pinellas County estimated that this area had lost roughly $70 million in hotel revenue even though beaches in this area did not receive any oil damage. This type of effect could be due to misperceptions about the spill, uncertainty about the future of the spill, or concerns about whether a tourism experience would be affected even if the destination is only within close proximity to a spill. Recreational resources that require investment in real estate or other long-term fixed assets may likewise be impacted by public perceptions. CoreLogic (2010) and Gittelsohn (2010) provide estimates of the extent to which the DWH event will negatively impact property values along the Gulf Coast. It is possible that some of these effects would be magnified if additional OCS activity added to fears of another oil spill. While the effects of an oil spill on tourism and recreational resources are complex and largely determined by the dynamics of a particular spill, the DWH event demonstrates that they must be considered as part of the full effects of a spill.

Oxford Economics (2010) attempts to quantify these effects by analyzing the impacts of recent catastrophic events on recreational economies. For example, they analyzed the *Ixtoc* oil spill of 1979, the scale and nature of which is reasonably similar to the DWH event. In this example, it took approximately 3 years for beaches to be cleaned and for recreational activity to return to similar levels as before the spill. More information regarding the economic effects of the *Ixtoc* spill can be found in (USDOI, BLM, 1982). They also looked at the *Prestige* oil spill of 2002 off the coast of Spain. Given the nature and size of that spill, recreational activity was able to return to pre-spill levels in approximately 1 year. More information regarding the *Prestige* spill can be found in Garza et al. (2009). Oxford Economics (2010) estimates that the long-term economic damage from the DWH event's resulting spill to be between $7.6 and $22.7 billion. Given Florida's dependence on fishing and beach activities (as well as the overall size of its economy), this study suggests that the State might bear the majority of the economic damage from the spill even though it experienced fewer physical impacts than did other states. However, this conclusion is highly uncertain since it depends so greatly on the role of perceptions on recreational activity. It is likely our understanding of the role of oil spills on perceptions and tourism will improve as the aftermath of the DWH event unfolds.

In light of the possibility of incomplete or unavailable information (e.g., ongoing economic studies after the DWH event that may shed light on the impacts to tourism), BOEMRE has determined that this information may be relevant to reasonably foreseeable significant adverse impacts in the event of a future spill, although more likely for a catastrophic spill. This information is not within BOEMRE's ability to obtain at this time. Much of this economic data is compiled by other Federal and State agencies and may be impacted by the NRDA process. This data may not be available for some time, and certainly not within the timeframe contemplated by this NEPA process. In any event, BOEMRE does not believe that this incomplete or unavailable information is essential to a reasoned choice among the alternatives given that the likelihood of a catastrophic spill occurring in the future remains remote, and given the level of existing data that are currently available.

Proposed Action Analysis

Spills of the magnitude of the DWH event are high impact but low-probability events. Catastrophic spills are discussed in **Appendix B**. The risk of a spill occurring from the WPA proposed action and contacting recreational beaches is described in Chapter 4.3.1.8 of the Multisale EIS. Figure 4-13 of the Multisale EIS displays the probabilities of oil spills ≥1,000 bbl occurring and contacting certain shorelines as a result of the WPA proposed action. The probabilities of an oil spill occurring and contacting the shoreline are greater than 0.5 percent in the following parishes and counties: Cameron Parish in Louisiana; and Aransas, Calhoun, Matagorda, Brazoria, Galveston, and Jefferson Counties in Texas. Figure 4-15 of the Multisale EIS provides the probabilities of oil spills ≥1,000 bbl occurring and contacting recreational beach areas or State offshore waters within 10 days as a result of the WPA proposed action. As can be seen, the Galveston (2-3% chance) and Matagorda Beach (3-4% chance) areas have a slightly higher probability to be impacted than other areas in the Gulf of Mexico due to the WPA proposed action. The areas around South Padre Island and western Louisiana each have around a 1 percent chance of impact, while areas eastward have a less than 0.5 percent chance of impacts to recreational beaches.

The ESI maps of the Texas coastline can be found using NOAA's ERMA mapping system (USDOC, NOAA, 2010j). Much of the Galveston Beach area is characterized by fine-grained sand beaches, while the Matagorda Beach area generally has coarser grained sand (which is somewhat more difficult to clean after an oil spill). The coasts of the inland bay systems in Texas, as well as much of the coast of Louisiana, have a number of marsh areas, which would be even more difficult to clean in the event of a spill reaching these areas. The inland bay system in Texas is particularly important for recreational fishing activity; more information on recreational fishing in Texas can be found in **Chapter 4.1.1.15**. However, it would likely take a reasonably large spill for the aggregate effects of an oil spill on recreational activity to be widespread.

Summary and Conclusion

Spills most likely to result from the WPA proposed action will be small, of short duration, and not likely to impact Gulf Coast recreational resources. Should an oil spill occur and contact a beach area or other recreational resource, it will cause some disruption during the impact and cleanup phases of the spill. However, these effects are also likely to be small in scale and of short duration. This is because the size of a coastal spill is projected to be small (coastal spills are assumed to be 5 bbl; Table 4-13 of the Multisale EIS) and because the probability of an offshore spill contacting most beaches is small. In the unlikely event that a spill occurs that is sufficiently large to affect large areas of the coast and, through public perception, have effects that reach beyond the damaged area, effects to recreation and tourism could be significant. The DWH event was such a case; the resulting spill damaged some coastal resources but had economic effects in a much larger area. The role of perceptions on tourism activity was a particularly important feature of the DWH event, one that should become better understood as the aftermath of the spill unfolds.

4.1.1.16.4. Cumulative Impacts

Background/Introduction

A detailed description of the cumulative effects on recreational resources can be found in Chapter 3.3.3 of the Multisale EIS. Additional information for the 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.14 of the 2009-2012 Supplemental EIS. The following information is a summary of the description of recreational resources incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The cumulative impacts to recreational resources would occur through the proposed action, the existing OCS Program, and from the expected impacts of external events and actions to recreational resources and tourism activity. The proposed action would contribute to a number of aesthetic and space-use issues arising from existing oil and gas programs. Oil spills can also impact the recreational uses of beaches and wetland areas, which are already being impacted through coastal erosion.

Aesthetic Impacts

Proposed WPA Lease Sale 218 would contribute to some negative aesthetic impacts of the existing OCS Program and State oil and gas programs. One concern is the extent to which discharges of marine debris from OCS actions would contribute to the existing marine debris problems experienced along the Gulf Coast. Debris can noticeably affect the aesthetic value of coastal areas, particularly beaches. This is particularly true given the significant levels of marine debris that already exist in some areas. Marine debris originates from OCS operations, sewage treatment plants, recreational and commercial fishing, industrial manufacturing, and various forms of vessel traffic. The United Nations Environment Programme (2009) presents a broad overview of the nature of the marine debris problem. Various government agencies participate in a coordinated effort to combat marine debris; a broad summary of the issues involved and the policy structure with respect to marine debris can be found in the report of the Interagency Marine Debris Coordinating Committee (USDOC, NOAA, 2008b). There is also a national monitoring program in place to track the progression of the marine debris problem in various locations. Sheavly (2007) describes the structure of the National Marine Debris Monitoring Program; Ocean Conservancy (2011) presents the results from the most recent round of debris monitoring. McIlgorm et al. (2009) present an economic analysis of the costs of marine debris and of programs designed to minimize debris. Finally, Barnea et al. (2009) outline some issues regarding debris removal that are unique to the Gulf of Mexico.

The discharge of marine debris is subject to a number of laws and treaties. These include the Marine Debris Research, Prevention, and Reduction Act; the Marine Plastic Pollution Research and Control Act; and the MARPOL-Annex V Treaty. Regulation and enforcement of these laws is conducted by a number of agencies, such as USEPA, NOAA, and USCG. The BOEMRE policy regarding marine debris prevention is outlined in NTL 2007-G03 (USDOI, MMS, 2007f). This NTL requires that OCS operators post informational placards that outline the legal consequences and potential ecological harms of discharging marine debris. This NTL also instructs OCS workers to complete annual marine debris prevention training, and operators are also instructed to develop a certification process for the completion of this training by their workers. These various laws, regulations, and NTL's will likely minimize the potential damage to recreational resources from the discharge of marine debris from OCS operations.

The oil platforms and infrastructure that arise from the WPA proposed action would contribute to the existing visibility of oil facilities along the Gulf Coast. The extent to which the visibility of OCS platforms can affect tourism depends primarily on the distance of platforms from shore and on the size of the particular oil rig. For example, a study by the Mississippi Development Authority found that a 50-ft (15-m) high production platform was identifiable 3 mi (5 km) from shore and a 100-ft (30-m) high production platform was visible 10 mi (16 km) from shore (Collins Center for Public Policy, 2010). All Federal OCS platforms in the WPA are 10 or more miles (16 or more kilometers) from shore. In addition, the visibility of infrastructure is unlikely to noticeably detract from recreational uses unless it was to block the sight path of significant landmarks, which is not the case for OCS platforms in the WPA. Finally, the WPA proposed action would contribute incrementally to helicopter and vessel noise due to routine OCS operations. This would likely be most acute during the construction phases near service-vessel ports. However, the use of approved traffic lanes and times should keep the disturbance of these activities to recreational users to a minimum.

Space-Use Conflicts

The WPA proposed action would contribute incrementally to space-use conflicts that exist between OCS operations and some recreational uses. Conflicts could primarily arise with recreational boaters and fishermen; the nature of the space use of OCS operations is discussed in Chapter 4.1.1.3.3.2 of the Multisale EIS. Space-use conflicts from the WPA proposed sale could occur in the CPA as well. Much of the recreational activity that could conflict with OCS operations occurs near parks and wildlife refuges; the locations of these sites, and other recreational use sites can be found using NOAA's ERMA mapping system. Brody et al. (2006) presents a methodology for analyzing space-use conflicts with oil and gas operations in the case of Texas. Space-use conflicts would be particularly prevalent near the Galveston/Houston area, which is home to both a large recreational economy and to a large amount of oil and gas processing facilities. An economic analysis of the various uses of Galveston Bay can be found in Ko (2007). The OCS vessel ports are presented in **Figure 3-4**; onshore infrastructure locations in the WPA are shown in Figure 3-13 of the Multisale EIS and are discussed in **Chapter 4.1.1.18.4**. In addition, since most ocean-based recreation occurs relatively close to shore, there would more likely be conflicts with State oil and gas programs than with the WPA proposed action. Overall, the incremental contribution of the WPA proposed action to potential sources of space-use conflict should be minimal.

Oil Spills and Beach/Wetland Depletion

The OCS Program occurs in an environment in which beach and wetland resources are undergoing depletion due to human development, hurricanes, and natural processes. An overview of coastal erosion threats can be found in *Evaluation of Erosion Hazards* (The Heinz Center, 2000). Government policy towards managing beach erosion can be found at the website of NOAA's Coastal Services Center. A recent example of a proposed beach nourishment project in Panama City Beach, Florida, is presented by COE (U.S. Dept. of the Army, COE, 2010). Oil spills have the potential to contribute to beach erosion, both due to contaminated sentiment and to the potential sediment losses during the cleanup process. This would have a particular impact on recreational activity in some of the high-volume beach areas such as those in Alabama and northwest Florida. However, beach cleaning techniques that are less damaging to beaches may become more prevalent during future years; a discussion of beach cleaning techniques is presented in Chapter 3.2.1.5.4 of the 2009-2012 Supplemental EIS. A more detailed discussion of the cumulative impacts of OCS actions on coastal beaches and dunes is presented in **Chapter 4.1.1.3.4**. Further information on the cumulative impacts on wetlands resources can be found in **Chapter 4.1.1.4.4**.

Summary and Conclusion

Proposed WPA Lease Sale 218 would contribute to low levels of aesthetic and space-use conflict with recreational activity that is expected to result cumulatively from the impacting factors. This is because much of the activities associated with the proposed action would be located at some distance from recreational areas. Oil spills could also contribute to the overall degradation being experienced by beach and wetland-based recreational resources, but these are usually localized and small-scale events. The dynamics of any possible future, large-scale oil spills would also be influenced by the damage done and lessons learned from the DWH event. However, the cumulative impact of the WPA proposed action to recreational resources is small since the incremental increase in the probability of a large spill is also low. The incremental contribution of the WPA proposed action is expected to be minimal, in light of all non-OCS-related activities such as aesthetic impacts (including from other industrial sources), wetland loss, and space-use conflicts.

4.1.1.17. Archaeological Resources

The BOEMRE has reexamined the analysis for archaeological resources presented in the Multisale EIS and the 2009-2012 Supplemental EIS. Archaeological resources are any material remains of human life or activities that are at least 50 years of age and that are of archaeological interest (30 CFR 250.105). This Supplemental EIS is based upon additional information available since the publication of these two documents and in consideration of the DWH event. Substantial new information that alters the impact conclusion for archaeological resources presented in the Multisale EIS and the 2009-2012 Supplemental EIS has come to light as a result of BOEMRE-sponsored studies and industry surveys; specifically, reports of damage to significant cultural resources (i.e., historic shipwrecks) have been confirmed in lease areas >200 m (656 ft) deep where no survey data were available. Although the exact cause of this damage is unknown, it may be linked to postlease bottom-disturbing activities. As part of the environmental reviews conducted for postlease activities, available information will be evaluated regarding the potential presence of archaeological resources within the proposed action area to determine if mitigation is warranted.

4.1.1.17.1. Historic

4.1.1.17.1.1. Description of the Affected Environment

A detailed description of historic archaeological resources can be found in Chapter 3.3.4.1 of the Multisale EIS. Additional information for the additional 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.15 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Historic archaeological resources on the OCS consist of historic shipwrecks. A historic shipwreck is defined as a submerged or buried vessel or their associated components, at least 50 years old, that has foundered, stranded, or wrecked and that is currently lying on or embedded in the seafloor. Ships are known to have traversed the waters of the WPA as early as Captain Alonso Alverez de Piñeda's expedition in 1519. Alvar Nuñez Cabeza de Vaca is likely to have the dubious distinction of being the first European to be shipwrecked along the Texas coast as early as 1528 (Francaviglia, 1998).

The NPS and this Agency contracted three studies (CEI, 1977; Garrison et al., 1989; Pearson et al., 2003) aimed at modeling areas in the GOM where historic shipwrecks are most likely to exist. The 1977 study concluded that two-thirds of the total number of shipwrecks in the northern Gulf lie within 1 mi (1.6 km) of shore and most of the remainder lie between 1 and 6 mi (1.6 and 10 km) of shore (CEI, 1977). Garrison et al. (1989) found that changes in the late 19th- and early 20th-century sailing routes increased the frequency of shipwrecks in the open sea in the eastern Gulf to nearly double that of the central and western Gulf (Garrison et al., 1989). The Garrison study also found the highest observed frequency of shipwrecks occurred within areas of intense marine traffic, such as the approaches and entrances to seaports and the mouths of navigable rivers and straits. Based on the results of this study, BOEMRE constructed a high-probability model for potential shipwreck locations of archaeological potential to guide decisions regarding which OCS lease blocks would require the operator to submit an archaeological report with their EP, DOCD, DPP, or other permit application.

Pearson et al. (2003) benefited from the experience of almost 15 years of high-resolution, shallow hazard surveys in lease blocks (a typical lease block is 9 mi^2 [5,760 ac]) and along pipeline routes. Some of these surveys (almost exclusively for pipeline routes) were conducted in deep water. Historic shipwrecks have, to date, been discovered through oil industry sonar surveys in water depths up to 6,500 ft (1,891 m). In fact, in the last 5 years, over a dozen shipwrecks have been located in deep water and nine of these ships have been confirmed visually as historic vessels. Many of these wrecks were not previously known to exist in these areas from the historic record. Taking these discoveries into account, the 2003 study then recommended including some deepwater areas, primarily on the approach to the Mississippi River, among those lease areas requiring archaeological investigation. With this in mind, BOEMRE revised its guidelines for conducting archaeological surveys and added about 1,200 lease blocks to the list of blocks requiring an archaeological survey and assessment. These requirements are posted on the BOEMRE website under NTL 2005-G07 and NTL 2008-G20. Since implementation of these new lease blocks on July 1, 2005, at least 39 possible historic sites have been reported in this area. Recent research on historic shipping routes, moreover, suggests that the ultra-deepwater area of the Gulf of Mexico, between 25º and 27.5º N. latitude, was located along the historic Spanish trade route, which therefore increases the probability that a historic shipwreck could be located in this area (Lugo-Fernandez et al., 2007). This route runs through the proposed sale area, and much of this area is not currently identified as requiring an archaeological assessment. A study to conduct archival research on these historic shipping routes was completed in 2010 (Krivor et al., in press) and concluded that both Spanish and French vessels were lost in the 16th, 17th, and 18th centuries while transiting the route between Vera Cruz, New Orleans, and Havana.

The BOEMRE shipwreck database currently lists 515 wrecks in the WPA (**Table 4-23**). Many of these reported shipwrecks may be considered historic and could be eligible for nomination to the National Register of Historic Places. Most of these wrecks are known only through the historical record and, to date, have not been located on the ocean floor. This list should not be considered exhaustive. Regular reporting of shipwrecks did not occur until late in the 19^{th} century, and losses of several classes of vessels, such as small coastal fishing boats, were largely unreported in official records. Three confirmed historic sites have been positively identified in the WPA through diver visual inspection. These include the Civil War gunboat USS *Hatteras* (41GV68), which currently is listed to the National Register, and the early 19th-century steamship *New York* (Irion and Ball, 2001), which was recently salvaged by for-profit treasure hunters (Bowers, 2008), and the Mexican freighter *Oaxaca* sunk by U-boat action in World War II. Nearly all of these have been discovered as a result of BOEMRE-mandated oil industry surveys.

Submerged shipwrecks off the coast of Texas are likely to be moderately well preserved because of the high sediment load in the water column from upland drainage and wind and water erosion. Wrecks occurring in or close to the mouth of bays likely would have been quickly buried by transported sediment and therefore somewhat protected from the destructive effects of wood-eating shipworms (*Teredo navalis*) or storms as has been observed at the site of *La Belle* in Matagorda Bay, Texas, and the Emanuel Point wrecks in Pensacola Bay, Florida. A good example of this type of historic wreck is French explorer Robert Sieur de LaSalle's *La Belle,* a shallow-draft French sailing vessel classified as a *barque longue* lost in 1686 and discovered in Matagorda Bay, Texas, in 1995 (Bruseth and Turner, 2005). Wrecks occurring in deeper water also have a moderate to high preservation potential. In the deep water, temperature at the seafloor is extremely cold, which slows the oxidation of ferrous metals. While the cold water at depth would eliminate the wood-eating shipworm *Teredo navalis*, it is clear from recent studies that other marine organisms consume wooden shipwrecks and that microbial organisms are at work breaking down steel and iron hulls (Atauz et al, 2006; Church et al., 2007; Church and Warren 2008; Ford et al., 2008). Due to the high levels of preservation and the decrease in impacts from anthropogenic and meteorological events (diving, looting, trawling, hurricanes, etc.), the potential for recovery of archaeological data is considerably higher for shipwrecks discovered at depth as opposed to those found in nearshore environments.

Aside from acts of war, hurricanes and intense cold fronts cause the greatest number of wrecks in the Gulf. Wrecks occurring as a result of an extremely violent storm are more likely to be scattered over a broad area. The wreckage of the 19th-century steamer *New York*, which was destroyed in a hurricane, lies in 52 ft (16 m) of water and has been documented by BOEMRE (Irion and Anuskiewicz, 1999; Gearhart et al., in press) as scattered over the ocean floor in a swath over 1,500 ft (457 m) long. Shipwrecks occurring in shallow water nearer to shore are more likely to have been reworked and scattered by subsequent storms than those wrecks occurring at greater depths on the OCS. Historic research indicates that shipwrecks occur less frequently in Federal waters. These wrecks are likely to be better preserved, less disturbed, and, therefore, more likely to be eligible for nomination to the National Register of Historic Places than are wrecks in shallower State waters.

Hurricane activity in the Gulf of Mexico has the ability to impact archaeological resources in water depths up to 130 ft (40 m) (Gearhart et al., in press). It is almost certain that any shipwrecks within the path of Hurricanes Katrina or Rita in shallow water were impacted to some extent by these storms. In September 2005, NPS conducted a study of sites along the Gulf Coast that were impacted by Hurricane Katrina (USDOI, NPS, 2005). This assessment identified three types of damage that can occur to archaeological sites: tree throws; storm surge, scouring, and erosion; and seabed shifting. On the OCS, the two primary types of damage would be associated with storm surge and seabed shifting. Damage from either of these activities could adversely affect both prehistoric and historic sites on the OCS. In early 2007, this Agency awarded a study to investigate the impacts that recent storm activity may have had on historic shipwrecks in the Gulf of Mexico. Remote-sensing surveys for this study were completed in May 2007, and dive operations were completed in October 2007. A final report of findings is expected in 2011. Analysis of the remote-sensing surveys and diver investigations indicates that at least 3 of the 10 shipwrecks examined were affected by recent storm activity and that older wooden wrecks that had achieved some level of equilibrium in their environment were less affected than more recent, steel-hulled wrecks (Gearhart et al., in press). This study on impacts to shipwrecks from hurricanes or other storm activity was limited to SCUBA-diving depths of less than 130 ft (40 m). A potential result of hurricane activity in water depths greater than 130 ft (40 m) may include mud flows, erosion, and the generation of strong underwater currents or mega-furrows (Bryant and Liu, 2000, p. 52).

4.1.1.17.1.2. Impacts of Routine Events

Background/Introduction

A detailed impact analysis of the possible effects of routine impacts associated with the proposed WPA lease sale on historical archaeological resources can be found in Chapter 4.2.1.1.12 of the Multisale EIS and in Chapter 4.1.15.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the impact analysis incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

Routine impact-producing factors associated with the WPA proposed action that could affect historical archaeological resources include direct physical contact with a shipwreck site; the placement of drilling rigs and production systems on the seafloor; pile driving associated with platform emplacement; pipeline placement; dredging of new channels, as well as maintenance dredging of existing channels; anchoring activities; pipeline installation; and the masking of archaeological resources from industry-related debris.

Offshore development could result in a drilling rig, platform, pipeline, dredging activity, or anchors having an impact on a historic shipwreck. Direct physical contact with a wreck site could destroy fragile ship remains, such as the hull and wooden, glass, or ceramic artifacts, and could disturb provenience of the artifacts, meaning their location in 3D space, their relationship to one another, and their relationship to the site as a whole. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the period from which the ship dates. Industry-related impacts have been found to have occurred in areas where archaeological reports had not been previously required (Atauz et al., 2006; Church and Warren, 2008). Remote-sensing surveys of the seafloor using high-resolution sidescan sonar and magnetometers have been found to be an effective means of locating historic submerged properties in order to avoid impacts from the undertaking.

The placement of drilling rigs and production systems has the potential to cause physical impact to prehistoric and/archaeological resources. The area of seafloor disturbance from each of these structures is defined in **Chapter 3.1.1.2**. Pile driving associated with platform emplacement may also cause sediment liquefaction an unknown distance from the piling, disrupting stratigraphy in the area of liquefaction.

According to estimates presented in **Table 3-2**, 177-287 exploration, delineation, development, and production wells would be drilled and 26-41 production platforms would be installed in support of the proposed action. Of these, 95-147 exploration, delineation, development, and production wells would be drilled, and 21-33 platforms would be installed in water depths of 200 m (656 ft) or less, where the majority of blocks previously identified as having a high potential for historic period shipwrecks are located. The location of any proposed activity within a lease that has a high potential for historic shipwrecks requires archaeological clearance prior to operations. While the expanded BOEMRE shipwreck database currently contains 515 reported shipwrecks in the entire western Gulf OCS (**Table 4-23**), this number is believed to represent a fraction of the actual number of ships lost in the WPA. As noted above, recent research on historic shipping routes, moreover, suggests that the ultra-deepwater area of the Gulf of Mexico, between 25º and 27.5º N. latitude, was located along the historic Spanish trade route, which therefore increases the probability that a historic shipwreck could be located in this area (Lugo-Fernandez et al., 2007). This route runs through the proposed sale area. Of the 5,240 lease blocks in the WPA, just over one-quarter (1,459) are leased. There are 1,548 blocks that fall within the Gulf of Mexico Region's high-potential areas for historic resources in the WPA. Of these blocks, 583 are in water depths of 200 m (656 ft) or less and would require a survey at 50-m linespacing. Twenty-three blocks are in water depths that preclude survey with a magnetometer and require a sidescan-sonar survey at no more that a 300-m linespacing. The potential of an interaction between rig or platform emplacement and a historic shipwreck is greatly diminished by requisite site surveys. In certain circumstances, the Regional Director may require the preparation of an archaeological report to accompany the EP, DOCD, or DPP, under 30 CFR 250.194. As part of the environmental reviews conducted for postlease activities, available information will be evaluated regarding the potential presence of archaeological resources within the proposed action area to determine if mitigation is warranted.

Pipeline placement has the potential to cause a physical impact to prehistoric and/archaeological resources. Pipelines placed in water depths of less than 200 ft (61 m) must be buried. Burial depths of 3 ft (1 m) are required with the exception of shipping fairways and anchorage areas, where the requirements are 10 ft (3.1 m) and 15 ft (4.6 m), respectively.

Maintenance dredging in support of activities resulting from the proposed action has the potential to impact a historic shipwreck. For instance, maintenance dredging in the Port Mansfield Entrance Channel is believed to have impacted the *Santa Maria de Yciar*, which sank on April 29, 1554 (Espey, Huston & Associates, 1990a) and is expected to impact the *SS Mary*, which sank on November 30, 1876, in Aransas Pass (Espey, Huston & Associates, 1990b). Impacts from maintenance dredging can be attributed proportionally to the users of the navigation channels. Port Mansfield is one of the smaller Texas ports and, although it has been a base for Gulf oil services operations in the past, today it is primarily a fishing community that attracts vacationers from around the State and beyond. Although bay fishing has remained feasible and has been a source of income to the locals, recently the mouth of the port (in addition to the jetties that provide access to the Gulf) has silted to the point that it may close the port (Siegesmund et al., 2008). Therefore, the impact to the *Santa Maria de Yciar* and *SS Mary*, which directly attributable to traffic and maintenance dredging as a result of the OCS Program, is negligible. As these shipwrecks are unique historic archaeological resources, maintenance dredging, in general, is responsible for impacts to historic shipwrecks. Proposed action activities represent <1 percent of the usage of the major navigation channels for the WPA.

Anchoring associated with platform and pipeline emplacement, as well as with service-vessel and shuttle-tanker activities, may also physically impact prehistoric and/archaeological resources. It is assumed that, during pipeline emplacement, an array of eight 20,000-lb anchors is continually repositioned around the pipelaying barge.

Activities resulting from the proposed action would generate metallic structures and debris, which would tend to mask magnetic signatures of significant historic archaeological resources. The task of locating historic resources through an archaeological survey is, therefore, made more difficult as a result of leasing activity.

Explosive seismic charges set off near historic shipwrecks may displace the surrounding sediments and cause loss of significant archaeological information regarding the context of the site. Furthermore, damage may result to the associated artifact assemblage.

Archaeological surveys, where required, are assumed to be effective in reducing the potential for an interaction between an impact-producing activity and a historic resource. The surveys are expected to be most effective in areas where there is only a thin veneer of unconsolidated Holocene sediments. In these areas, shipwreck remains are more likely to be exposed at the seafloor where they can be detected by the side-scan sonar as well as the magnetometer. In areas of thicker unconsolidated sediments, shipwreck remains are more likely to be completely buried, with detection relying solely on magnetometer. With sites that are buried, and therefore more difficult to identify, the preservation potential is higher and thus the potential for significant archaeological data is also higher. At the current survey line-spacing requirement of 50 m, studies have concluded that a sizeable shipwreck would likely be detected on at least one survey line (Garrison et al., 1989; Enright et al., 2006, p. 129). By the same token, however, "small wooden-hulled vessels, whether machine- or sail-powered, are unlikely to be detected by 300-m (984-ft) surveys in most instances" (Enright et al., 2006, p. 129). In the WPA, 959 lease blocks are designated as having a high potential for containing submerged prehistoric sites, but a low potential for historic shipwrecks, and are surveyed at a 300-m survey interval.

Summary and Conclusion

The greatest potential impact to an archaeological resource as a result of the WPA proposed action would result from direct contact between an offshore activity (i.e., platform installation, drilling rig emplacement, and dredging or pipeline project) and a historic site. Archaeological surveys, where required prior to an operator beginning oil and gas activities on a lease, are expected to be effective at identifying possible archaeological sites. The technical requirements of the archaeological resource reports are detailed in NTL 2005-G07, "Archaeological Resource Surveys and Reports." Under 30 CFR 250.194(c) and 30 CFR 250.1010(c), lessees are required to notify this Agency immediately of the discovery of any potential archaeological resources.

Offshore oil and gas activities resulting from the proposed action could impact an archaeological resource because of incomplete knowledge on the location of these sites in the Gulf. The risk of contact to archaeological resources is greater in instances where archaeological survey data is unavailable. Such an event could result in the disturbance or destruction of important archaeological information. Archaeological surveys, where required, would provide the necessary information to develop avoidance strategies that would reduce the potential for impacts on archaeological resources.

Except for the projected 0-1 new gas processing plants and 0-1 new pipeline landfall, the WPA proposed action would require no new oil and gas coastal infrastructure. It is expected that archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities.

4.1.1.17.1.3. Impacts of Accidental Events

Background/Introduction

A detailed impact analysis of the possible effects of accidental impacts associated with the proposed WPA lease sale on historical archaeological resources can be found in Chapter 4.4.13.1 of the Multisale EIS and in Chapter 4.1.15.3 of the 2009-2012 Supplemental EIS. The following information is a summary of the impact analysis incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

Impacts on historic archaeological resources could occur as a result of an accidental oil spill. A major effect from an oil spill would be visual contamination of a historic coastal site, such as a historic fort or lighthouse. Such effects would be temporary and reversible. The use of dispersants, however, could result in chemical contamination of submerged cultural heritage sites.

The effect, if any, of chemical dispersant use on the sea surface over a wide area and at depth at the Macondo wellhead in 2010 on submerged shipwrecks is still not known. While the Macondo well is located in the CPA, the impacts from the DWH event may be used as an analogy for activities that are planned in the WPA. It is known that there are at least seven historically significant archaeological resources within 20 mi (32 km) of the Macondo wellhead. A recent site investigation of corals approximately 7 mi (11 km) from the Macondo wellhead revealed that the corals were potentially impacted by the oiling event. "The proximity of the site to the disaster, the depth of the site, the clear evidence of recent impact, and the uniqueness of the observations all suggest that the impact found is linked to the exposure of this community to either oil, dispersant, extremely depleted oxygen, or some combination of these or other water-borne effects resulting from the spill" (Penn State, 2010). This has implications for the possible oiling of shipwrecks and the microbiological organisms that are consuming these steel-hulled vessels. According to Church et al. (2007, p. 205), the observed bioaccumulation of oxidized forms of iron at the site of the *Alcoa Puritan*, generated by microbial activity in 2004 (located 12 mi [19 km] from the Macondo wellhead), was parallel to the degradation of the remains of the RMS *Titanic*. It is unknown at this time, but it is hypothesized that microbial activity may be accelerated or retarded by compounds and elements associated with the release of millions of gallons of hydrocarbons and dispersants in the water column. At this time, little information is available on the condition of these shipwreck sites and the reaction to the oil spill. Additionally, there is also no information about the impacts of microbial activity on wooden shipwreck sites in deep water. Further study is warranted for both wooden shipwrecks and steel-hulled vessels to properly assess the impacts on these historically significant archaeological resources.

Other impacts that remain unknown at this time include the effect that the oiling of archaeological resources would have on the ability to conduct future chemical and observational analysis on the artifact assemblage. Currently, it is unknown if the release of hydrocarbons or of dispersant would impede an analysis that may aid in interpreting and understanding the archaeological record.

Although information on the impacts of a potential spill to archaeological resources is incomplete or unavailable at this time, and may be relevant to reasonably foreseeable adverse impacts on these resources, the information is not essential to a reasoned choice among alternatives. An oil spill occurring and contacting an archaeological resource is unlikely, given that oil released tends to rise to the surface quickly and the average size of any spill would be small.

The major impacts to both coastal historic and prehistoric sites from the *Exxon Valdez* spill in Alaska in 1989 were related to cleanup activities such as the construction of helipads, roads, and parking lots and to looting by cleanup crews rather than from the oil itself (Bittner, 1996). As a result, cultural resources were recognized as significant early in the response to the DWH event, and archaeologists were embedded in SCAT's and were consulting with cleanup crews. Although the process took several weeks to fully form, historic preservation representatives eventually were stationed at both the Joint Incident Command as well as each Area Command under the general oversight of the National Park Service to coordinate response efforts (Odess, official communication, 2010).

Summary and Conclusion

Accidental events producing oil spills may threaten archaeological resources along the Gulf Coast. Should a spill contact a historic archaeological site (including submerged sites), damage might include direct impact from oil-spill cleanup equipment and contamination of materials. The major effect from an oil-spill impact would be visual contamination of a historic coastal site, such as a historic fort or lighthouse. Given recent experience, it is expected that any spill cleanup operations would be considered a Federal action for the purposes of Section 106 of the NHPA and would be conducted in such a way as to cause little or no impacts to historic archaeological resources. Recent research suggests the impact of direct contact of oil on historic properties may be long term and not easily reversible without risking damage to fragile historic materials (Chin and Church, 2010). Previously unrecorded sites could be impacted by oil-spill cleanup operations on beaches and offshore. As indicated in Chapter 4.3.1.8 of the Multisale EIS and in **Table 3-5,** it is not very likely for an oil spill to occur, and it would not be likely to contact submerged, coastal or barrier island historic sites as a result of the WPA proposed action.

The potential for spills is low, the effects would generally be temporary and localized, and the cleanup efforts would be regulated. The proposed action, therefore, is not expected to result in impacts to historic archaeological sites; however, should such an impact occur, unique or significant archaeological information could be lost, and this impact could be irreversible.

4.1.1.17.1.4. Cumulative Impacts

An impact analysis for cumulative impacts in the WPA on historical archaeological resources can be found in Chapter 4.5.14.1 of the Multisale EIS and in Chapter 4.1.15.4 of the 2009-2012 Supplemental EIS.

Of the cumulative scenario activities, those that could potentially impact historic archaeological resources include the following: (1) the OCS Program; (2) State oil and gas activity; (3) maintenance dredging; (4) OCS sand borrowing; (5) artificial rigs-to-reef development; (6) offshore LNG projects; (7) renewable energy and alternative use conversions; (8) commercial fishing; (9) sport diving and commercial treasure hunting, and (10) hurricanes.

Archaeological surveys, where required prior to an operator beginning oil and gas activities on a lease, are assumed to be highly effective in reducing the potential for an interaction between an impact-producing activity and a historic resource. The surveys are expected to be most effective in areas where there is only a thin veneer of unconsolidated Holocene sediments. In these areas, shipwreck remains are more likely to be exposed at the seafloor where they can be detected by the side-scan sonar as well as the magnetometer. In areas of thicker unconsolidated sediments, shipwreck remains are more likely to be completely buried with detection relying solely on magnetometer.

According to estimates presented in Table 4-5 of the Multisale EIS, an estimated 38,677-45,338 exploration, delineation, and development wells would be drilled, and 2,958-3,262 production platforms would be installed as a result of the OCS Program. Of this range, between 19,840 and 22,216 exploration, delineation, and development wells would be drilled, and 2,779-2,991 production structures would be installed in water depths of 200 m (656 ft) or less. The majority of lease blocks in this water depth have a high potential for historic shipwrecks. Archaeological surveys were first required for Lease Sale 32 held in December 1973; therefore, it is assumed that any major impacts on historic resources that were caused by OCS Program activities occurred from development prior to this time.

Of the 17,649 lease blocks in the OCS Program area, less than half of these blocks are leased. There are 2,938 blocks that fall within the Gulf of Mexico Region’s currently designated, high-potential areas for archaeological resources. Of these blocks, 1,395 blocks are in water depths of 200 m (656 ft) or less and would require a survey at 50-m linespacing. The potential of an interaction between MODU or platform emplacement and a historic shipwreck is greatly diminished by requisite site surveys, where required, but it still exists in areas where surveys have not been required in the past. Such an interaction could result in the loss of or damage to significant or unique historic resources.

Table 4-4 of the Multisale EIS indicates that the placement of between 9,470 and 66,550 km (5,884-41,352 mi) of pipelines is projected in the cumulative activity area. While the required archaeological survey minimizes the chances of impacting a historic shipwreck, there remains a possibility that a wreck could be impacted by pipeline emplacement. Such an interaction could result in the loss of significant or unique historic resources.

The setting of anchors for drilling rigs, platforms, and pipeline lay barges, and anchoring associated with oil and gas service-vessel trips to the OCS have the potential to impact historic wrecks. Archaeological surveys serve to minimize the chance of impacting historic wrecks; however, these surveys are not infallible, and the chance of an impact from future activities does exist. Impacts from anchoring on a historic shipwreck may have occurred. There is also a potential for future impacts from anchoring on a historic shipwreck. Such an interaction could result in the loss of or damage to significant or unique historic resources and the scientific information they contain.

The probabilities of offshore oil spills ≥1,000 bbl occurring from OCS Program activities is presented in **Chapter 3.1.1.3**. Oil spills have the potential to impact coastal historic sites directly or indirectly by physical impacts caused by oil-spill cleanup operations. The impacts caused by oil spills to coastal historic archaeological resources are generally short term and reversible. **Table 4-24** presents the coastal spill scenario from both OCS and non-OCS sources. It is assumed that the majority of the spills would occur around terminals and be contained in the vicinity of the spill. Should such oil spills contact a historic site, the effects would be temporary and reversible.

Past, present, and future OCS oil and gas exploration and development and commercial trawling would result in the deposition of tons of metallic debris on the seafloor. Modern marine debris associated with these activities would tend to mask the magnetic signatures of historic shipwrecks, particularly in areas that were developed prior to requiring archaeological surveys. Such masking of the signatures characteristic of historic shipwrecks may have resulted or may yet result in OCS activities in the cumulative activity area, impacting a shipwreck containing significant or unique historic information.

State oil and gas program wells, structures, and pipelines in State waters are not under the jurisdiction of BOEMRE with respect to the archaeological resource protection requirements of the National Historic Preservation Act (NHPA). However, other Federal agencies, such as COE, which issues permits associated with pipelines in State waters, are responsible for the protection of archaeological resources under the NHPA. Therefore, the impacts that might occur to archaeological resources by pipeline construction originating from OCS-related activity within State waters should be mitigated under the requirements of the NHPA, and the same archaeological surveys for planned pipelines that lead into a landfall or a tie-in to a pipeline in State waters are required. Prior to 1989, it is possible that explosive seismic surveys on the OCS and within State waters could have impacted historic shipwrecks. Explosive seismic charges set near historic shipwrecks could have displaced the vessel's surrounding sediments, acting like a small underwater fault and moving fragile wooden, glass, ceramic, and metal remains out of their initial cultural context. Such an impact would have resulted in the loss of significant or unique archaeological information.

Maintenance dredging takes place in existing, often well-used, and marked seaways and transit corridors within which any historic wrecks already would have been disturbed or their historical context destroyed. Most channel dredging occurs at the entrances to bays, harbors, and ports. These areas have a high potential for historic shipwrecks; the greatest concentrations of historic wrecks are likely associated with these features (Pearson et al., 2003). It is reasonable to assume that significant or unique historic archaeological information has been lost as a result of past channel dredging activity. In many areas, COE requires remote-sensing surveys prior to dredging activities to minimize such impacts. Routine maintenance dredging, as an ongoing activity in well-plied channels, is not likely to result in any new disturbance or disruption to historic wrecks.

The OCS sand borrowing is expected to be an activity on the increase during the OCS cumulative activities period. Approximately 76 million yd^3 of OCS sand is liable to be accessed for coastal restorations over the next 5-10 years from Ship Shoal Blocks 88 and 89 and from South Pelto Blocks 12 and 13, primarily. For these bottom-disturbing activities, a preconstruction archaeological survey is required by BOEMRE for the borrow site lease. No new disturbance of historic shipwrecks would be expected when a predeployment archaeological survey of sand borrow sites is first examined for sea-bottom anomalies by BOEMRE so that the proper setback distances can be required that allow potential resources to be avoided.

Artificial reef development, offshore LNG projects, and renewable energy projects and alternative use conversions are expected to remain at, respectively, a steady pace of activity, to decrease, and to increase as competing uses of the OCS. A preconstruction archaeological survey is required before bottom-disturbing activities are permitted for artificial reef emplacement (if not reefed on site), deepwater ports for LNG facilities, and new-built renewable energy facilities. Alternative-use conversions of existing infrastructure likely would not involve new bottom-disturbing activities, but if called for in applications, a preconstruction survey would be required. No new disturbance of historic shipwrecks would be expected when predeployment archaeological surveys are first examined for sea-bottom anomalies by BOEMRE, or the permitting agency, so that proper setback distances can be required that allow mitigation potential resources to be avoided.

Commercial fishing trawling activity specifically would only affect the uppermost portions of the sediment column (Garrison et al., 1989). On many wrecks, the uppermost portions would already be disturbed by natural processes and would contain artifacts that have lost all original historic context.

Sport diving and commercial treasure hunting are significant factors in the loss of historic data from wreck sites. Efforts to educate sport divers and to foster the protection of historic shipwrecks, such as those of the Texas Historical Commission and the Texas Archeological Stewardship Program (Texas Historical Commission, 2010), would serve to lessen these potential impacts. While commercial treasure hunters generally impact wrecks with intrinsic monetary value, sport divers may collect souvenirs from all types of wrecks. Since the extent of these activities is unknown, the impact cannot be quantified. A Spanish war frigate, *El Cazador*, was discovered in the eastern Gulf of Mexico; it contained a large amount of silver coins and has been impacted by treasure-hunting salvage operations (McLaughlin, 1995). The historic data available from this wreck and from other wrecks that have been impacted by treasure hunters and sport divers represent a significant or unique loss.

Hurricanes and tropical storms are normal occurrences in the GOM and along the Gulf Coast. On average, 15-20 hurricanes make landfall along the northern Gulf Coast per decade. Shipwrecks in shallow waters are exposed to a greatly intensified, longshore current during tropical storms (Clausen and Arnold, 1975). Under such conditions it is highly likely that artifacts (e.g., ceramics and glass) would be dispersed. Some of the original information contained in the site would be lost in this process, but a significant amount of information would also remain. Overall, a significant loss of data from historic sites has probably occurred, and will continue to occur, in the northeastern Gulf from the effects of tropical storms. Some of the data lost have most likely been significant or unique

Summary and Conclusion

Several impact-producing factors may threaten historic archaeological resources, all related to bottom-disturbing activities. An impact could result from contact between historic shipwreck located on the OCS and OCS Program or State oil and gas activities (i.e., pipeline and platform installations, drilling rig emplacement and operation, dredging, structure removal, site clearance, and anchoring activities). Bottom-disturbing activities on the OCS also include maintenance dredging, sand borrowing, transported artificial reef emplacement, LNG facility construction, and renewable energy facility construction; with the exception of maintenance dredging, preconstruction surveys may be required by BOEMRE or the permitting agency. Impacts resulting from the imperfect knowledge of the location of historic resources could occur in areas where resources are buried and where a magnetometer survey is only required at 300-m (98-ft) survey intervals or not at all. The OCS development prior to requiring archaeological surveys has been documented to have impacted wrecks containing significant or unique historic information. This was amply demonstrated when a pipeline was laid across a previously unknown early 19th-century shipwreck and when an MODU mooring anchor chain cut a shipwreck in half (Atauz et al., 2006; Church and Warren, 2008). The archaeological resources regulation at 30 CFR 250.194 grants authority in certain cases to each BOEMRE Regional Director to require archaeological reports to be submitted with the EP, DOCD, or DPP where deemed necessary. As part of the environmental reviews conducted for postlease activities, available information will be evaluated regarding the potential presence of archaeological resources within the proposed action area to determine if mitigation is warranted. The loss or discard of metallic debris associated with oil and gas exploration and development and trawling activities could result in the masking of historic shipwrecks or the identification of false negatives on archaeological surveys (an anomaly that does not appear to be of historical significance, but actually is).

Damage to or loss of significant or unique historic archaeological information from commercial fisheries (trawling) is highly likely (Foley, 2010). It is expected that maintenance dredging, commercial bottom trawling, sport diving and commercial treasure hunting, and hurricanes and tropical storms have impacted and would continue to impact historic period shipwrecks.

Development onshore as a result of the proposed action could result in the direct physical contact between a historic site and pipeline trenching. It is assumed that archaeological investigations prior to construction would serve to mitigate these potential impacts. The expected effects of oil spills on historic coastal resources are temporary and reversible.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in the loss of significant or unique historic archaeological information. In the case of factors related to OCS

Program activities of the past within the cumulative activity area, it is reasonable to assume that most impacts would have occurred prior to 1973 (the date of initial archaeological survey and site clearance requirements) or in areas where high-resolution surveys have not been required. Future OCS Program activities and the bottom-disturbing activities permitted by BOEMRE and other agencies may require preconstruction archaeological surveys that, when completed, are highly effective in identifying bottom anomalies that could be avoided or investigated before bottom-disturbing activities begin. When surveys are not required, it is impossible to anticipate what might be imbedded in or lying directly on the seafloor, and impacts to these sites are likely to be major in scale. Conditional mitigation that may be applied following site-specific NEPA analysis prior to activities taking place is expected to greatly reduce potential impacts to archaeological resources. Despite diligence in site-clearance survey reviews, there is still the possibility of an unanticipated interaction between bottom-disturbing activity (i.e., rig emplacement, pipeline trenching, anchoring, and other ancillary activities) and a historic shipwreck. The incremental contribution of the proposed action is expected to be very small due to the efficacy of the remote-sensing surveys and archaeological reports, where required.

4.1.1.17.2. Prehistoric

4.1.1.17.2.1. Description of the Affected Environment

A detailed description of prehistoric archaeological resources can be found in Chapter 3.3.4.2 of the Multisale EIS. Additional information for the additional 181 South Area and any new information since the publication of the Multisale EIS is presented in Chapter 4.1.15.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Available evidence suggests that sea level in the northern GOM was at least 90 m (295 ft), and possibly as much as 130 m (427 ft), lower than present sea level during the period 20,000-17,000 years Before Present (B.P.) (Nelson and Bray, 1970). Sea level in the northern Gulf reached its present stand around 3,500 years B.P. (Pearson et al., 1986). For the past 60 years, it was generally accepted by archaeologists that the earliest humans in North America were the so-called Clovis peoples, named for a lanceolate-shaped, fluted projectile point first found near Clovis, New Mexico. The Clovis culture was thought to have entered the continent by way of Beringia, a land mass connecting Asia to North America exposed during the Last Glacial Maximum, and along an ice-free corridor opened between the Cordilleran and Laurentide ice sheets around 13.5 ka BP (thousands of years before present). Today, however, a growing body of evidence has dispelled the “Clovis First” model with discovery of several sites with indisputable pre-Clovis dates in the eastern United States (Goodyear, 2005), Chile (Dillehay, 1989; Meltzer et al., 1997), and central Texas (Waters et al., 2011). The Buttermilk Creek Complex identified by Waters et al. (2011) at the Debra L. Friedkin Site (41BL1239) is the nearest to the Gulf of Mexico Region and is dated from ~13.2 to 15.5 ka BP.

Establishing a reliable date for the entrance of Native Americans into the coastal regions of the Gulf is complicated by the fact that archaeological deposits pre-dating 3500 B.C. lie buried under as much as 40 m (131 ft) of sediment or are underwater on the OCS (Rees, 2010). Conclusive evidence for prehistoric sites of the Western Planning Area OCS is sparse. The McFaddin Beach Site (41JF50) in Jefferson County, Texas, has produced hundreds of artifacts 8,000 years old or older that have been redeposited from sites eroding from the now-submerged Pleistocene shoreline. Forty-three percent of the total sample includes artifacts diagnostic of the Middle and Late Paleo-Indian periods and include Clovis, Dalton, Scottsbluff, and San Patrice points (Stright et al., 1999). Because these artifacts come from a redeposited context and were selectively collected, it is impossible to determine if pre-Clovis sites may exist offshore.

Based on the best evidence currently available, the First Americans arrived on the Gulf Coast in the WPA around 11,500 B.C. (Rees, 2010).

The sea-level curve for the northern GOM proposed by Coastal Environments, Inc. (CEI) suggests that sea level at 12,000 years B.P. would have been approximately 45-60 m (148-197 ft) below the present-day sea level (CEI, 1977 and 1982). On this basis, the continental shelf shoreward of the 45- to 60-m (148- to 197-ft) bathymetric contours has potential for prehistoric sites dating after 12,000 years B.P. Because of inherent uncertainties in both the depth of sea level and the entry date of prehistoric man into North America, this Agency adopted the 60-m (197-ft) water depth as the seaward extent for archaeological site potential in GOM region.

Based on their 1977 baseline study, CEI (1977) proposed that sites analogous to the types of sites frequented by Paleo-Indians can be identified on the now-submerged shelf. Geomorphic features that have a high potential for associated prehistoric sites include barrier islands and back-barrier embayments, river channels and associated floodplains and terraces, and salt-dome features. Remote-sensing surveys have been very successful in identifying these types of geographic features, which have a high potential for associated prehistoric sites. Recent investigations in Louisiana and Florida indicate the mound-building activity by prehistoric inhabitants may have occurred as early as 6,200 years B.P. (cf. Haag, 1992; Saunders et al., 1992; Russo, 1992). Therefore, manmade features, such as mounds, may also exist in the shallow inundated portions of the OCS.

Regional geological mapping studies by BOEMRE allow interpretations of specific geomorphic features and assessments of archaeological potential in terms of age, the type of system the geomorphic features belong to, and geologic processes that formed and modified them. The potential for site preservation must also be considered as an integral part of the predictive model. In general, sites protected by sediment overburden have a high potential for preservation from the destructive effects of marine transgression. The same holds true for sites submerged in areas subjected to low wave energy and for sites on relatively steep shelves, which were inundated during periods of rapid rise in sea level. Although many specific areas in the Gulf having a high potential for prehistoric sites have been identified through required archaeological surveys, industry generally has chosen to avoid these areas rather than conduct further investigations.

Holocene sediments form a thin veneer or are absent over the majority of the continental shelf off western Louisiana and eastern Texas (USDOI, MMS, 1984). Many large, late Pleistocene, fluvial systems (e.g., the Sabine-Calcasieu River Valley) are within a few meters of the seafloor in this area. Farther to the south and west, a blanket of Holocene sediments overlays the Pleistocene horizon. In the western Gulf, prehistoric sites representing the Paleo-Indian culture period through European contact have been reported. The McFaddin Beach site, east of Galveston in the McFaddin National Wildlife Refuge, has produced late Pleistocene megafaunal remains and lithics from all archaeological periods, including a large percentage of Paleo-Indian artifacts (Stright et al., 1999). A study funded by this Agency to locate prehistoric archaeological sites in association with the buried Sabine-Calcasieu River Valley was completed in 1986 (CEI, 1986). Five types of relict landforms were identified and evaluated for archaeological potential. Coring of selected features was performed, and sedimentary analyses suggested the presence of at least two archaeological sites. A study funded by BOEMRE, "Examining and Testing Potential Prehistoric Archaeological Features on the Gulf of Mexico Outer Continental Shelf," is scheduled for completion in 2011.

Surveys from other areas of the eastern part of the WPA have produced evidence of floodplains, terracing, and point-bar deposits in association with relict late Pleistocene fluvial systems. Prehistoric sites associated with these features would have a high potential for preservation. Salt diapirs with bathymetric expression have also been recorded during lease-block surveys in this area. Solution features at the crest of these domes would have a high potential for preservation of associated prehistoric sites. The Salt Mine Valley site on Avery Island is a Paleo-Indian site associated with a salt-dome solution feature (CEI, 1977). The proximity of most of these relict landforms to the seafloor facilitates further investigation and data recovery.

A good-faith effort was made to identify any impacts to known prehistoric sites in the western Gulf as a result of recent hurricane activity; however, no such information was identified. It is possible that storm activity associated with Hurricane Rita may have impacted prehistoric sites in the shallow-water zone along the relict Sabine River valley because of its proximity to the seafloor surface.

4.1.1.17.2.2. Impacts of Routine Events

Background/Introduction

A detailed impact analysis of the possible effects of routine impacts associated with the proposed WPA lease sale on prehistoric archaeological resources can be found in Chapter 4.2.1.1.12.2 of the Multisale EIS and in Chapter 4.1.15.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the impact analysis incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared

Proposed Action Analysis

Blocks with a high potential for prehistoric archaeological resources are found landward of the 12,000-years-B.P. shoreline position, which is roughly approximated by the last geologic still-stand before inundation at approximately 13,000 years B.P. This 13,000-years-B.P. still-stand also roughly follows the 45-m (148-ft) bathymetric contour. Because of inherent uncertainties in both the depth of historic sea-level stands and the entry date of prehistoric man into North America, BOEMRE has adopted the 60-m (197-ft) water depth as the seaward extent of the area considered to have potential for prehistoric archaeological resources.

Offshore development as a result of the WPA proposed action could result in an interaction between a drilling rig, platform, pipeline, dredging activity, or anchors and an inundated prehistoric site. This direct physical contact with a site could destroy fragile artifacts or site features and could disturb artifact provenance and site stratigraphy. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for North America, Central America, South America, and the Caribbean.

The placement of drilling rigs and production systems has the potential to cause physical impact to prehistoric archaeological resources. The area of seafloor disturbance from each of these structures is defined in **Chapter 3.1.1.2.2**. Pile driving associated with platform emplacement may also cause sediment liquefaction an unknown distance from the piling, disrupting stratigraphy in the area of liquefaction.

Pipeline placement has the potential to cause a physical impact to prehistoric archaeological resources. Pipelines placed in water depths of <60 m (200 ft) must be buried. Burial depths of 1 m (3.28 ft) are required, with the exception of shipping fairways and anchorage areas, where the requirements are 9.84 ft (3 m) and 15 ft (4.6 m), respectively. Anchoring associated with platform and pipeline emplacement, as well as with service-vessel and shuttle-tanker activities, may also physically impact prehistoric archaeological resources. It is assumed that, during pipeline emplacement, an array of eight 20,000-lb anchors is continually repositioned around the pipelaying barge.

Onshore prehistoric archaeological resources include sites, structures, and objects such as shell middens, earth middens, campsites, kill sites, tool manufacturing areas, ceremonial complexes, and earthworks. Prehistoric sites that have yet to be identified would have to be assessed after discovery to determine the uniqueness or significance of the information that they contain. Sites already listed in the National Register of Historic Places and those considered eligible for the Register have already been evaluated as having the potential for making a unique or significant contribution to science. Of the unidentified coastal prehistoric sites that could be impacted by onshore development, some may contain unique information.

Onshore development as a result of the proposed action could result in direct physical contact between construction of new onshore facilities or a pipeline landfall and a previously unidentified prehistoric site. Direct physical contact with a prehistoric site could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast region.

Since all platform locations within the high-potential areas for the occurrence of offshore prehistoric archaeological resources are given archaeological clearance prior to setting the structure, removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with the findings of the *Programmatic Environmental Assessment: Structure Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDOI, MMS, 1987).

Except for the projected 0-1 new gas processing plant and 0-1 new pipeline landfall, the proposed action would require no new oil and gas coastal infrastructure. Any facility constructed must receive approval from the pertinent Federal, State, county/parish, and/or community involved. Protection of archaeological resources in these cases is expected to be achieved through the various approval processes involved. There should, therefore, be no impact to onshore prehistoric sites from onshore development related to the proposed action.

In order to reduce the risk of impacting a prehistoric archaeological resource during a BOEMRE-permitted activity, BOEMRE requires a 300-m (984-ft), remote-sensing survey linespacing for lease blocks that have been identified as having a high potential for containing prehistoric resources. The current NTL—NTL 2005-G07, effective July 1, 2005—supersedes all other archaeological NTL's and Letters to Lessees and Operators, and it clarifies the updated information to reflect current technology. The list of lease blocks requiring an archaeological survey and assessment are identified in NTL 2008-G20.

Summary and Conclusion

The greatest potential impact to an archaeological resource as a result of the WPA proposed action would result from direct contact between an offshore activity (i.e., platform installation, drilling rig emplacement, and dredging or pipeline project) and a prehistoric site. Prehistoric archaeological sites are thought potentially to be preserved shoreward of the 45-m (148-ft) bathymetric contour, where the Gulf of Mexico continental shelf was subaerially exposed during the Late Pleistocene. The archaeological survey and archaeological clearance of sites, where required prior to an operator beginning oil and gas activities on a lease, are expected to be somewhat effective at identifying submerged landforms that could support possible archaeological sites. The NTL 2005-G07 suggests a 300-m (984-ft) linespacing for remote-sensing surveys of leases within areas having a high potential for prehistoric sites. While surveys provide a reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric archaeological site, there is a possibility of an OCS activity contacting an archaeological site because of an insufficiently dense survey grid. Should such contact occur, there would be damage to or loss of significant and/or unique archaeological information.

4.1.1.17.2.3. Impacts of Accidental Events

Background/Introduction

A detailed impact analysis of the possible effects of accidental impacts associated with the proposed WPA lease sale on prehistoric archaeological resources can be found in Chapter 4.4.13.2 of the Multisale EIS and in Chapter 4.1.15.3 of the 2009-2012 Supplemental EIS. The following information is a summary of the impact analysis incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

Oil spills resulting from a well blowout in the WPA and related spill-response activities have the potential to impact cultural resources near the spill site and landfall areas. Although information on the actual impacts from the DWH event are inconclusive at this time, it is expected that impacts on prehistoric archaeological sites in the CPA have occurred through hydrocarbon contamination of organic materials, which have the potential to date site occupation through radiocarbon dating techniques, as well as possible physical disturbance associated with spill cleanup operations. Since archaeological sites are protected under law, it is expected that any spill cleanup operations would be conducted in such a way as to cause little or no impacts on archaeological resources, given recent experience .

The major impacts to prehistoric sites from the *Exxon Valdez* spill in Alaska in 1989 were related to cleanup activities such as the construction of helipads, roads, and parking lots and to looting by cleanup crews rather than from the oil itself (Bittner, 1996). As a result, cultural resources were recognized as significant early in the response to the DWH event, and archaeologists were embedded in SCAT's and were consulting with cleanup crews. Although the process took several weeks to fully form, historic preservation representatives eventually were stationed at both the Joint Incident Command as well as each Area Command under the general oversight of the National Park Service to coordinate response efforts (Odess, official communication, 2010). However, should an oil spill directly contact a coastal prehistoric site, unique or significant archaeological information could be lost, and this impact would be irreversible.

Summary and Conclusion

Accidental events producing oil spills may threaten archaeological resources along the Gulf Coast. Should a spill contact a prehistoric archaeological site, damage might include loss of radiocarbon-dating potential, direct impact from oil-spill cleanup equipment, and/or looting. Previously unrecorded sites could be impacted by oil-spill cleanup operations on beaches. As indicated in Chapter 4.3.1.8 of the Multisale EIS, it is not very likely for an oil spill to occur and contact coastal and barrier island prehistoric sites as a result of the WPA proposed action. The proposed action, therefore, is not expected to result in impacts to prehistoric archaeological sites.

4.1.1.17.2.4. Cumulative Impacts

An impact analysis for cumulative impacts in the WPA on prehistoric archaeological resources can be found in Chapter 4.5.14.2 of the Multisale EIS and in Chapter 4.1.15.4 of the 2009-2012 Supplemental EIS. The following information is a summary of the impact analysis incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Future OCS exploration and development activities in the Gulf of Mexico between 2007 and 2046, which can be found in Table 4-4 of the Multisale EIS, projects drilling 12,966-14,187 exploration, delineation, and development wells in water depths <60 m (197 ft). Relative sea-level curves for the Gulf of Mexico indicate there is no potential for the occurrence of prehistoric archaeological sites in water depths >60 m (197 ft). Archaeological surveys are assumed to be highly effective in reducing the potential for an interaction between an impact-producing activity and a prehistoric resource. Archaeological surveys were first required for Lease Sale 32 held in December 1973; therefore, it is assumed that the major impacts to prehistoric resources that may have occurred resulted from development prior to this time. The potential of an interaction between rig or platform emplacement and a prehistoric site is diminished by the survey, but it still exists. Such an interaction would result in the loss of or damage to significant or unique prehistoric information.

The placement of 2,340-9,580 km (1,454-5,953 mi) of pipelines in water depths <60 m (197 ft) is projected as a result of OCS Program activities in the WPA. For the OCS Program, 5,320-31,690 km (5,320-19,691 mi) of pipelines are projected in water depths <60 m (197 ft). While the archaeological survey minimizes the chances of impacting a prehistoric site, there remains a possibility that a site could be impacted by pipeline emplacement. Such an interaction would result in the loss of significant or unique archaeological information.

The setting of anchors for drilling rigs, platforms, and pipeline lay barges, and anchoring associated with oil and gas service-vessel trips to the OCS have the potential to impact shallowly buried prehistoric sites. Archaeological surveys minimize the chance of impacting these sites; however, these surveys are not seen as infallible, and the chance of an impact from future activities exists. Impacts from anchoring on a prehistoric site may have occurred. Such an interaction could result in the loss of significant or unique archaeological information.

The probabilities of offshore oil spills ≥1,000 bbl occurring from the OCS Program in the cumulative activity area is presented in **Chapter 3.3**. Oil spills have the potential to impact coastal prehistoric sites directly or indirectly by physical impacts caused by oil-spill cleanup operations. Coastal, oil-spill scenario numbers are presented in Table 4-13 of the Multisale EIS for both OCS and non-OCS sources. It is assumed that the majority of the spills would occur around terminals and would be contained in the vicinity of the spill. There is a small possibility of these spills contacting a prehistoric site. The impacts caused by oil spills to coastal prehistoric archaeological resources can severely distort information relating to the age of the site. Contamination of the organic site materials by hydrocarbons can make radiocarbon dating of the site more difficult or even impossible. This loss might be ameliorated by using artifact seriation or other relative dating techniques. Coastal prehistoric sites might also suffer direct impact from oil-spill cleanup operations as well as looting resulting from interactions between persons involved in cleanup operations and unrecorded prehistoric sites. Interaction between oil-spill cleanup equipment or personnel and a site could destroy fragile artifacts or disturb site context, possibly resulting in the loss of information on the prehistory of North America and the Gulf Coast region. Some coastal sites may contain significant or unique information.

Most channel dredging occurs at the entrances to bays, harbors, and ports. Bay and river margins have a high potential for the occurrence and preservation of prehistoric sites. Prior channel dredging has disturbed buried and/or inundated prehistoric archaeological sites in the coastal plain of the Gulf of Mexico. It is assumed that some of the sites or site information were unique or significant. In many areas, COE requires surveys prior to dredging activities to minimize such impacts.

Trawling activity would only affect the uppermost portion of the sediment column (Garrison et al., 1989). This zone would already be disturbed by natural factors, and site context to this depth would presumably be disturbed. Therefore, no effect of trawling on prehistoric sites is assumed. Investigations prior to construction can determine whether prehistoric archaeological resources occur at these sites.

Table 4-9 of the Multisale EIS indicates the projected coastal infrastructure related to OCS Program activities in the cumulative activity area. Investigations prior to construction can determine whether prehistoric archaeological resources occur at these sites.

Because BOEMRE does not have jurisdiction over pipelines in State waters, the archaeological resource protection requirements of the NHPA are not within BOEMRE's jurisdiction. However, other Federal agencies, such as COE, which issues permits associated with pipelines in State waters, are responsible for the protection of archaeological resources under the NHPA. Therefore, the impacts that might occur to archaeological resources by pipeline construction within State waters should be mitigated under the requirements of the NHPA.

Over 100 hurricanes have made landfalls along the northern Gulf of Mexico coast from the Florida Panhandle to Texas over the past century (Liu and Fearn, 2000; Keim and Muller, 2009). Prehistoric sites in shallow waters and on coastal beaches are exposed to the destructive effects of wave action and scouring currents. Under such conditions, it is highly likely that artifacts would be dispersed and the site context disturbed. Some of the original information contained in the site would be lost in this process. Overall, a significant loss of data from prehistoric sites has probably occurred, and will continue to occur, in the northeastern Gulf from the effects of tropical storms.

Summary and Conclusion

Several impact-producing factors may threaten prehistoric archaeological resources of the Gulf of Mexico. An impact could result from contact between proposed oil and gas activities (including pipeline construction, platform installation, drilling rig emplacement and operation, dredging, and anchoring activities) and an oil spill and subsequent cleanup efforts. Each of these activities or events could damage and destroy a prehistoric archaeological site located on the continental shelf. Archaeological surveys, where required, and the resulting archaeological analyses completed prior to an operator beginning oil and gas activities on a lease are expected to be highly effective at identifying possible prehistoric sites. The OCS development prior to the first required archaeological survey in 1973 has possibly impacted sites containing significant or unique prehistoric information, and it is possible that, even with current surveys,, prehistoric archaeological sites may be missed. No significant new information was found at this time that would alter the overall conclusion that cumulative impacts on prehistoric archaeological sites associated with the WPA proposed action is expected to be minimal. Because of continued regulations and surveys, where required, potential impact from the WPA proposed action to prehistoric archeological resources would be decreased.

Additionally, should an oil spill occur and contact a coastal prehistoric site, loss of significant or unique information could result. Oil spills have the potential to impact coastal prehistoric sites directly or indirectly by physical impacts caused by oil-spill cleanup operations.

The initial dredging of ports and navigation channels and tropical storms are assumed to have caused the loss of significant archaeological information.

Onshore development as a result of the OCS Program could result in the direct physical contact between a prehistoric site and new facility construction and pipeline trenching. It is assumed that archaeological investigations prior to construction would serve to mitigate these potential impacts.

The shallow depth of sediment disturbance caused by commercial fisheries activities (trawling) is not expected to exceed that portion of the sediments that have been disturbed by wave-generated forces.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in the loss of significant or unique prehistoric archaeological information. In the case of factors related to OCS Program activities in the cumulative activity area, it is reasonable to assume that most impacts would have occurred prior to 1973 (the date of initial archaeological survey requirements). The incremental contribution of the proposed action is expected to be very small due to the efficacy of the required remote-sensing survey and concomitant archaeological report and clearance.

4.1.1.18. Human Resources and Land Use

4.1.1.18.1. Land Use and Coastal Infrastructure

The BOEMRE has reexamined the analysis for land use and coastal infrastructure presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below and in consideration of the DWH event. While some new information was found, none of it conclusively changes the description of environmental effects. It is too early to determine substantial, long-term changes as a result of the DWH event and the subsequent drilling suspension. The BOEMRE anticipates that there will be some long-term consequences and these will become apparent over time. Additionally, for the interim, BOEMRE recognizes the need to continue monitoring all resources for changes that are applicable for land use and infrastructure. Short-term impacts and potential long-term impacts related to the DWH event, in general, and the drilling suspension, in particular, are discussed at the end of the sections below on the "Description of the Affected Environment" (**Chapter 4.1.1.18.1.1**) and "Impacts of Accidental Events" (**Chapter 4.1.1.18.1.3**).

A detailed description of the affected environment and full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action and the proposed action's incremental contribution to the cumulative impacts are presented in the Multisale EIS. A summary of those analyses and their reexamination due to new information and the addition of the 181 South Area is presented in the 2009-2012 Supplemental EIS. The following is a summary of the information presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The WPA proposed action would not require additional coastal infrastructure, with the possible exception of 0-1 new gas processing facility and 0-1 new pipeline landfall, and it would not alter the current land use of the analysis area. In fact, as industry responds to the post-suspension environment, increased scrutiny of industry practices post-DWH event, and pending regulatory revisions, the 0-1 projection range becomes even more conservative, i.e., it becomes even more likely that the number would be zero (Dismukes, official communication, 2010a). Thus, the existing oil and gas infrastructure is expected to be sufficient to handle development associated with the proposed action. There may be some expansion at current facilities, but the land in the analysis area is sufficient to handle such development. There is also sufficient land to construct a new gas processing plant in the unlikely event that one should be needed. However, because the current spare capacity at existing facilities should be sufficient to satisfy new gas production, any such need would likely materialize only toward the end of the 40-year life of the proposed action (Dismukes, official communication, 2010a). This excess capacity substantially diminishes the likelihood of new facility construction. Existing solid-waste disposal infrastructure is adequate to support both existing and projected offshore oil and gas drilling and production needs. Minor accidental events such as oil or chemical spills, blowouts, and vessel collisions would have no long-term negative effects on land use. Coastal or nearshore spills, as well as vessel collisions, could have short-term adverse effects on coastal infrastructure, requiring the cleanup of any oil or chemicals spilled. The incremental contribution of the proposed action to the cumulative impacts on land use and coastal infrastructure are expected to be minor. A full catastrophic event analysis of impacts from an event such as DWH event can be found in **Appendix B**.

4.1.1.18.1.1. Description of the Affected Environment

For the WPA proposed action, the primary region of geographic influence is coastal Texas and Louisiana. Land use in the area has not substantially changed since the Multisale EIS (Chapter 3.3.5.1.2) or the 2009-2012 Supplemental EIS (Chapter 4.1.16.1.1) and that description is summarized below.

The coastal zone of the northern GOM is not a physically, culturally, or economically homogenous unit (Gramling, 1984). The counties and parishes along the coasts of Texas and Louisiana represent some of the most valuable coastline in the U.S. Not only does it include miles of recreational beaches and the protection of an extended system of barrier islands, but it also has deepwater ports, oil and gas support industries, manufacturing, farming, ranching, and hundreds of thousands of acres of wetlands and protected habitat. These counties and parishes vary in their histories and in the composition and economic activities of their respective local governments.

According to the U.S. Department of Agriculture's Economic Research Service, which classifies counties into economic types that indicate primary land-use patterns, 2 of the 74 counties/parishes in the analysis area are classified as farming dependent, 9 as mining dependent (suggesting the importance of oil and gas development to these local economies), 17 as manufacturing dependent, 9 as government employment centers, and 3 as tied to service employment. The Economic Research Service also classifies counties in terms of their status as a retirement destination; 11 of the 74 counties/parishes are considered major retirement destinations and 1 of the rural counties is classified as recreation dependent (U.S. Dept. of Agriculture, Economic Research Service, 2004). The varied land-use patterns are displayed in Figure 3-16 of the Multisale EIS.

The BOEMRE defines the analysis area for potential impacts on population, labor, and employment as that portion of the GOM coastal zone whose social and economic well-being (population, labor, and employment) is directly or indirectly affected by the OCS oil and gas industry. In this description of the socioeconomic environment, sets of counties (and parishes in Louisiana) have been grouped on the basis of intercounty commuting patterns into Labor Market Areas (LMA's), as identified by Tolbert and Sizer (1996). The methodology employed by Tolbert and Sizer is fully described in Chapter 3.3.5.1.1 of the Multisale EIS. Along the Gulf Coast, from the southern tip of Texas to Miami and the Florida Keys, 23 LMA's are identified and comprise the 13 BOEMRE-defined Economic Impact Areas (EIA's) for the Gulf of Mexico region. The counties and parishes that form the LMA's and EIA's are listed in **Table 4-25** and the EIA's are visually illustrated in **Figure 2-2**. The LMA's geographically adjacent to the WPA are all within Texas and include Brownsville, Corpus Christi, Victoria, Brazoria, Houston-Galveston, and Beaumont-Port Arthur. Use of the LMA geography brings together not only counties immediately adjacent to the GOM but also counties tied to coastal counties as parts of functional economic areas. An analysis that encompasses where people live as well as where they work permits a more meaningful assessment of the impact of offshore oil and gas activities. Because exploration, development, and production activities on the OCS draw on existing infrastructural, economic, and labor capacity from across the GOM region, the socioeconomic impacts of the proposed action in an individual planning area (WPA, CPA, and EPA) are not limited to geographically adjacent areas. For this reason, BOEMRE's impact analysis analyzes the potential impacts in all 13 EIA's regardless of where the proposed action is taking place.

The Texas Gulf coastal plain constitutes over one-third of the State and includes forest, cattle and farmlands, major cities of commerce and education, tourist locales, Federal installations, and major ports. The oil and gas industry has been part of its economy since the early 1900's. The majority of oil and gas corporations have headquarters in Houston. The military also has a significant presence.

The Louisiana coastal area includes broad expanses of marshes and swamps interspersed with ridges of higher well-drained land. Southeastern Louisiana is a thriving metropolitan area hosting shipping, navigation, U.S. Navy facilities, and oil and chemical refineries. Historically, Terrebonne, Plaquemines, and Lafourche Parishes have been the primary staging and support area for offshore oil and gas exploration and development.

An extensive maritime industry exists in the northern GOM. There is a substantial amount of domestic waterborne commerce in the analysis area and also some foreign maritime traffic. For the year 2005, 10 of the leading 25 U.S. ports ranked by total trade tonnage are located in Texas and Louisiana (American Association of Port Authorities, 2007). Chapter 3.3.5.6 of the Multisale EIS includes a detailed description of the Gulf maritime industry in the analysis area.

Infrastructure that supports oil and gas exploration and development in the GOM region is far reaching and consists of several categories including platform fabrication yards, shipyards, shipbuilding manufacturers, service bases, port facilities, pipeline manufacturers, pipecoating yards, waste management facilities, transportation facilities, gas processing plants, natural gas storage facilities, LNG facilities, refineries, and petrochemical plants, to name a few.

The OCS-related offshore infrastructure includes offshore production systems, platform fabrication, pipelines, barges, service vessels, and helicopters. Chapter 3.3.5.7 of the Multisale EIS describes the various types of offshore infrastructure.

The OCS-related coastal infrastructure is large, supports OCS development, and consists of thousands of small and large contractors covering virtually every facet of OCS activity, including service bases, construction facilities for platform fabrication, pipecoating, pipelines, shipbuilding, and processing facilities such as gas processing plants, refineries and petrochemical plants, as well as terminal facilities such as pipeline shore facilities, barge terminals, and it also includes waste disposal facilities. Chapter 3.3.5.8 of the Multisale EIS details the various types of infrastructure mentioned above.

See Chapter 3.3.3 of the Multisale EIS for a listing of major public, recreational, and conservation areas; Chapter 3.3.5.6 of the Multisale EIS for a discussion of major ports and waterways; and Figures 3-13 through 3-15 of the Multisale EIS for a description of OCS infrastructure.

***Deepwater Horizon* Event**

In response to the DWH event, Department of the Interior Secretary Ken Salazar imposed a suspension on all offshore drilling. The initial suspension was modified on May 27, 2010, to allow drilling only in shallow waters less than 500 ft (152 m) deep (USDOI, Office of Public Affairs, 2010a). However, only a limited amount of drilling has actually resumed because of new information requirements as clarified in NTL 2010-N06, the time it takes for operators to comply, and the rate at which BOEMRE is able to process permit applications (Weinstein, 2010). For example, from June 28, 2010, when new requirements were announced, until September 10, 2010, there were 13 Applications to Permit Drilling filed; of the 13, five had been approved and eight were pending (USDOI, Office of Public Affairs, 2010b). On October 12, 2010, the last remaining deepwater drilling suspension was lifted, but, as in the case of shallow-water drilling, deepwater drilling would not re-commence immediately and is dependent upon operators fulfilling stringent requirements and BOEMRE approvals. The lingering impacts of the suspension and permitting delays were experienced at Port Fourchon, where rental rates were cut by 30 percent as an incentive for businesses to stay. In the months following the blowout and the declared suspension, companies have removed a large portion of their equipment from Port Fourchon, and there was a substantial decrease in helicopter flights and servicing of rigs. Many companies have had to trim their budgets by cutting hours and salaries. Support services companies, such as chemical suppliers, and welders, were also negatively affected (Lohr, 2010). The effects of this decreased demand would rippled through the various infrastructure categories (e.g., fabrication yard, shipyards, port facilities, pipecoating facilities, gas processing facilities, waste management facilities, etc.) and also affected the oil and gas support sector businesses (e.g., drilling contractors, offshore support vessels, helicopter hubs, mud/drilling fluid/lubricant suppliers, etc.). For example, the lingering impacts of the suspension and permitting delays are being experienced at Port Fourchon, where rental rates were cut by 30 percent through June 30, 2011 as an incentive for businesses to stay. This amounted to a $3 million revenue loss for the Greater Lafourche Port Commission. As of June 2011, businesses operating out of Port Fourchon were collectively operating at about 30 percent capacity compared with pre-DWH levels. Activity levels are very slowly improving at Port Fourchon, and according to the Executive Port Director at Fourchon, the main concern now is the current pace of exploration plan approvals. While production has been ongoing since the DWH event, the majority of the Port's business is in drilling and exploration activities (Chaisson, official communication, 2011). The BOEMRE will continue to monitor these infrastructure effects as they evolve over time. Although this information on infrastructure effects is evolving and may be relevant to reasonably foreseeable significant impacts to the Gulf economy, this information would not be essential to a reasoned choice among the alternatives because regardless of whether the decisionmaker chooses to hold a lease sale under the action alternatives or chooses the No Action alternative, there are still pre-existing OCS leases in the WPA that would continue to support the economy. Any individual lease sale would not be expected to, on its own, result in significant impacts.

Land use experienced a more immediate but short-term impact, with temporary waste staging areas and decontamination areas that were set up to handle the spill-related waste. Concerns about waste management practices were expressed by government and the public (Barringer, 2010). The USEPA, in consultation with the Coast Guard, issued solid waste management directives to address the issue of contaminated materials, and solid or liquid wastes that were recovered as a result to cleanup operations (USEPA, 2010f). Fifteen waste staging areas spread out across Louisiana, and there were no waste staging areas in Texas. No decontamination areas were set up in either Louisiana or Texas. The USEPA visited each staging and decontamination area once per week and each landfill two times per month, and they documented their findings on the USEPA public website. There were some issues, but nothing that would appear to cause a long-term impact (USEPA, 2010f). Additional description of the DWH event's waste stream is found in **Chapter 4.1.1.18.4**.

4.1.1.18.1.2. Impacts of Routine Events

Background/Introduction

A detailed impact analysis of routine events on land use and coastal infrastructure for proposed WPA Lease Sale 218 can be found in Chapter 4.2.1.1.13.1 of the Multisale EIS. Impact analyses for the 181 South Area that includes any new information since publication of the Multisale EIS is presented in Chapter 4.1.16.1.2 of the 2009-2012 Supplemental EIS. The following information is a summary of the impact analysis incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

Impact-producing factors associated with the WPA proposed action that could affect land use and coastal infrastructure include (1) gas processing facilities, (2) pipeline landfalls, (3) service bases, (4) navigation channels, and (5) waste disposal facilities.

Chapter 4.1.2.1 of the Multisale EIS and Chapter 3.1.2 of the 2009-2012 Supplemental EIS discuss OCS-related coastal infrastructure and projected new coastal infrastructure that may result from the WPA proposed action or the OCS Program, including the potential need for the construction of new facilities and/or the expansion of existing facilities. Based on current information, the development scenario presented in the 2009-2012 Supplemental EIS has been reconsidered and revised for proposed WPA Lease Sale 218, but changes have been few. All onshore infrastructure requires permits for construction and operation. The BOEMRE is not the permitting agency for these activities. The permitting agencies for any onshore infrastructure would be the State in which the activity would occur, and/or COE, and/or USEPA. According to the scenario analysis in the Multisale EIS and the 2009-2012 Supplemental EIS, the construction of 0-1 new gas processing facilities would be expected to occur near the end of the 40-year life of a single WPA lease sale. Most of the projected new pipeline would be offshore and would tie into the existing offshore pipeline infrastructure. According to the scenario analysis, 0-1 new pipeline landfalls would be expected to occur toward the end of the 40-year lifespan of the proposed lease sale. According to these BOEMRE projections, no other new coastal infrastructure would be expected to result from a single WPA lease sale. Given the uncertain environment of the post-DWH event, the application of the scenario revised for the proposed WPA Lease Sale 218 is very conservative since the likelihood is diminished that any new gas processing facility or pipeline landfall would result from a single WPA lease sale. That is, the lingering effects of the drilling moratorium, changes in Federal requirements for drilling safety, and subsequent slowdown in the permit-approval process has depressed existing demand for gas processing facilities and pipeline landfalls; hence, the likelihood of new gas processing facilities or pipeline landfalls has moved closer to zero and farther from one (Dismukes, official communication, 2010a). However, BOEMRE recognizes the need to continue monitoring all resources for changes that are applicable for land use and infrastructure. Maintenance dredging of existing navigation channels is still expected, but no new navigation channels are expected to be dredged as a result of proposed WPA Lease Sale 218. The volume of OCS generated waste is closely correlated with the level of offshore drilling and production activity. Demand for waste disposal facilities is influenced by the volume of waste generated. At this time, it is unclear how long the current slowdown in activity will continue or how it might affect later years. Until OCS drilling activity recovers, the potential for a new waste facility as a result of proposed WPA Lease Sale 218 is highly unlikely.

Chapter 4.1.2.1.4.2 of the Multisale EIS and Chapter 3.1.2.2 of the 2009-2012 Supplemental EIS discuss gas processing plants and the potential for new facilities and/or expansion at existing facilities. Over the past 5 years, there has been a substantial decrease in offshore natural gas production, partially as a result of increasing emphasis on onshore shale gas development, which is less expensive to produce and provides larger per-well production opportunities and reserve growth. Also, there has been a trend toward more efficient gas processing facilities with greater processing capacities. For example, in Texas, the average daily processing capacity per plant increased from 66 million cubic feet (MMcf) to 95 MMcf between 1992 and 2006 (USDOE, Energy Information Administration, 2006). While natural gas production on the OCS shelf (shallow water) has been rapidly declining, deepwater gas production has been increasing, but not quickly enough to make up the difference. Increasing onshore shale gas development, declining offshore gas production, and the increasing efficiency and capacity of existing gas processing facilities are trends that have combined to lower the need for new gas processing facilities along the Gulf Coast in the past 5 years. Combined with this, existing facilities that were already operating at about 50 percent of capacity prior to the 2005 hurricane season are operating at even lower capacity utilization levels now. Spare capacity at existing facilities should be sufficient to satisfy new gas production for many years, although there remains a slim chance that a new gas processing facility may be needed by the end of the 40-year life of the proposed action (Dismukes, official communication, 2010c).

The BOEMRE analyzes the potential for new pipeline landfalls to determine the potential impacts to wetlands and other coastal habitats. In Chapter 4.1.2.1.7 of the Multisale EIS and other previous EIS's and EA's, BOEMRE assumed that the majority of new Federal OCS pipelines would connect to the existing infrastructure in Federal and State waters and that very few would result in new pipeline landfalls. Therefore, BOEMRE projected up to one pipeline landfall per lease sale. Between the Multisale EIS and the 2009-2012 Supplemental EIS, BOEMRE tested this assumption by analyzing past lease sale outcomes (USDOI, MMS, 2007d). This analysis shows that it is generally unlikely that even one landfall would result from an individual WPA lease sale. A mature pipeline network already exists in the Gulf of Mexico and companies have very strong financial incentives to reduce their costs by designing and utilizing pipeline systems to their fullest extent possible. Companies consider "economies of scale" in pipeline transportation, maximizing the amount of product moved through a constructed pipeline to decrease the long-run, average cost of production. Mitigation costs for any new wetland and environmental impacts, as well as various landowner issues at the landfall point, are additional considerations. These are strong incentives to move new production into existing systems and to avoid creating new landfalls (USDOI, MMS, 2007d). This analysis confirms BOEMRE's assumption that the majority of new pipelines constructed would connect to the existing infrastructure in Federal and State waters and that very few would result in new pipeline landfalls. However, there may be instances where new pipelines would need to be constructed. Location would be a determining factor; if there are no existing pipelines reasonably close and it is more cost effective to construct a pipeline to shore, then there may be a new OCS pipeline landfall. However, the very strong financial incentives to link into the existing, mature pipeline network make this highly unlikely (Dismukes, official communication, 2010d). **Chapters 4.1.1.3.2 and 4.1.1.4.2** provide a detailed discussion of coastal barrier beaches and wetlands, respectively, and potential pipeline landfall impacts to those resources.

Chapters 3.3.5.8.1 and 4.1.2.1.1 of the Multisale EIS and Chapter 3.1.2.1 of the 2009-2012 Supplemental EIS present a description of OCS-related service bases. A service base is a community of businesses that load, store, and supply equipment, supplies, and personnel that are needed at offshore work sites. The proposed action is not projected to change existing OCS-related service bases or require construction of new service bases. Instead, it would contribute to the use of existing service bases. **Figure 3-4** shows the 50 service bases the industry currently uses to service the OCS. These facilities are identified as the primary service bases from plans received by BOEMRE. The ports of Fourchon, Cameron, Venice, and Morgan City, Louisiana, are the primary service bases for Gulf of Mexico mobile rigs. Major platform service bases in the WPA are Galveston, Freeport, and Port O'Connor, Texas; and Cameron, Fourchon, Intracoastal City, Morgan City, and Venice, Louisiana.

Service bases are utilized for three types of OCS offshore support: supply vessel, crewboat, and helicopter. Supply vessels transport pipe and bulk supplies, and the supply vessel base serves as the loading point and provides temporary storage. Crewboats transport personnel and small supplies. Collectively, supply vessels and crewboats are known as "OSV's" (offshore supply vessels). There are approximately 1,200 OSV's operating in the GOM. Important drivers for the OSV market include the level of offshore exploration and drilling activities, current oil and gas prices, expectations for future oil and gas prices, and customer assessments of offshore prospects (Dismukes, in preparation-b). High demand for OSV's translates into a positive impact on OCS-related employment (see **Chapter 4.1.1.18.3.2**, "Economic Factors," below). Helicopters transport small supplies and workers and also may patrol pipelines to spot signs of damage or leakage. Helicopters service drilling rigs, production platforms, and pipeline terminals, as well as specialized vessels, such as jack-up barges. The OCS activity levels and offshore oil and gas industry transportation needs substantially influence the demand for and profitability of helicopter services (Dismukes, in preparation-b). Exploration and development plans filed with BOEMRE identify the expected number and frequency of vessel and helicopter trips, and the primary and secondary service bases for each project. In the event of changes in weather or operation conditions, a small amount of vessel and helicopter traffic may be dispatched from other bases. However, these deviations would occur on a temporary basis, and vessel traffic and helicopter transport should return to the primary and secondary bases as timely as possible.

Chapter 4.1.2.1.9 of the Multisale EIS and Chapter 3.1.2.1 of the 2009-2012 Supplemental EIS discuss navigation channels along the Gulf Coast. Much of the traffic navigating these channels is unrelated to OCS activity, and the current system of navigation channels in the northern GOM is projected to be adequate for accommodating any additional traffic generated by proposed WPA Lease Sale 218. The Gulf-to-port channels and the Gulf Intracoastal Waterway that support prospective OCS ports are generally deep and wide enough to handle OCS-related traffic and are maintained by regular dredging (**Figure 3-5**). The COE is the responsible Federal agency for the regulation and oversight of navigable waterways. The maintained depths for these waterways are shown in Table 3-36 of the Multisale EIS. All single lease sales contribute to the demand for OSV support; hence, it also contributes to the vessel traffic that moves in and out of support facilities. Therefore, proposed WPA Lease Sale 218 is likely to contribute to the continued need for maintenance dredging of existing navigation channels. However, no new navigation channels are expected to be dredged as a result of the proposed action because the existing system of navigation channels is projected to be adequate to allow proper accommodation for vessel traffic that will occur as a result of the proposed action. Maintenance dredging is essential for proper water depths in channels to allow all shipping to move safely through the waterways to ports, services bases, and terminal facilities. Several million cubic yards of sand, gravel, and silt are dredged from waterways and harbors every year. This is a controversial process because it necessarily occurs in or near environmentally sensitive areas such as valuable wetlands, estuaries, and fisheries (Dismukes, in preparation-b). **Chapter 4.1.1.4.2** provides a detailed discussion of wetlands and the impacts of navigation channel dredging.

Chapter 4.1.2.2 of the Multisale EIS and Chapter 4.1.16.1.2 of the 2009-2012 Supplemental EIS discuss OCS waste disposal. These analyses and other previous EIS's and EA's concluded that no new solid-waste facilities would be built as a result of a single lease sale or as a result of the OCS Program. Recent research further supports these past conclusions that existing solid-waste disposal infrastructure is adequate to support both existing and projected offshore oil and gas drilling and production needs (Dismukes et al., 2007). The industry trend is toward innovative methods to handle wastes to reduce the potential for environmental impacts; e.g., hydrocarbon recovery/recycling programs, slurry fracture injection, treating wastes for reuse as road base or levee fill, and segregating waste streams to reduce treatment time and improve oil recovery. The volume of OCS waste generated is closely correlated with the level of offshore drilling and production activity (Dismukes, in preparation-a). Before the DWH event, BOEMRE analyses indicated that there was an abundance of solid waste capacity in the GOM region and thus highly unlikely that any new waste facilities would be constructed. If any increase in the need for capacity develops, it would probably be met by expansion of existing facilities. However, now it is unclear whether this would remain true, and more research is needed (Dismukes, official communication, 2010e). In recent months, due to the drilling suspension and subsequent permit approval slowdown, there has been some reduction in offshore drilling activity, which is slowly ramping back up. Given this situation, demand for waste disposal facilities may not be likely to increase. However, at this time BOEMRE cannot predict how long this current pace will continue or how long it will take for activity levels to recover. The BOEMRE will continue to monitor waste-disposal demands and activity in the post-DWH event environment. **Chapter 4.1.1.18.4.2** provides a discussion of environmental justice issues related to waste disposal facilities.

Summary and Conclusion

The impacts of routine events associated with proposed WPA Lease Sale 218 are uncertain due to the post-DWH environment, the lingering effects of the drilling suspensions, the changes in Federal requirements for drilling safety, and the current pace of permit approvals. The BOEMRE projects 0-1 new gas processing facilities and 0-1 new pipeline landfalls for a single WPA lease sale. However, based on the most current information available, there is only a very slim chance that either would result from proposed WPA Lease Sale 218, and if a new gas processing facility or pipeline landfall were to result, it would likely occur toward the end of the 40-year analysis period. The likelihood of a new gas processing facility or pipeline landfall is much closer to zero than to one (Dismukes, official communication, 2010a). The BOEMRE anticipates that there would be maintenance dredging of navigation channels and an increase in activity at services bases as a result of proposed WPA Lease Sale 218. If drilling activity recovers post-DWH event and increases, there could be new increased demand for a waste disposal services as a result of proposed WPA Lease Sale 218. Because of the current near zero estimates for pipeline landfalls and processing facility construction, the routine activities associated with the WPA proposed action would have little effect on land use.

As a result of the DWH event, it is too early to determine substantial, long-term changes in routine event impacts to land use and infrastructure. The BOEMRE anticipates these changes will become apparent over time. Therefore, BOEMRE recognizes the need to continue monitoring all resources for changes that are applicable for land use and infrastructure. From the information that is currently available, in regard to land use and infrastructure, it does not appear that there would be adverse impacts from routine events associated with proposed WPA Lease Sale 218.

4.1.1.18.1.3. Impacts of Accidental Events

Background/Introduction

Impacts of accidental events on land use and coastal infrastructure for proposed WPA Lease Sale 218 are discussed in Chapter 4.4.14.1 of the Multisale EIS. Impact analyses for the 181 South Area that includes new information since publication of the Multisale EIS is presented in Chapter 4.1.16.1.3 of the 2009-2012 Supplemental EIS. The following information is a summary of the impact analysis incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Proposed Action Analysis

Accidental events (impact-producing factors) associated with the WPA proposed action that could affect land use and coastal infrastructure include (1) oil spills, (2) vessel collisions, and (3) chemical/drilling-fluid spills. The DWH event was an accidental event of historic and catastrophic proportion, the largest blowout in U.S. history, and the first to occur on the OCS in over 30 years. Such events should be distinguished from accidental events that are smaller in scale and that occur more frequently. Chapter 4.3.1.3 of the Multisale EIS provides a detailed discussion of oil spills that have occurred and their frequency. Detailed analysis of a high-impact, low-probability catastrophic event such as the DWH event is provided in **Appendix B**.

Oil spills may be associated with exploration, production, or transportation activities that result from the WPA proposed action. Detailed risk analysis of offshore oil spills ≥1,000 bbl and coastal spills associated with the WPA proposed action is provided in Chapters 4.3.1.5, 4.3.1.6, and 4.3.1.7 of the Multisale EIS, respectively. Because oil spilled in the offshore areas normally volatilizes and is dispersed by currents, it has a low probability of contacting coastal areas. Oil spills in coastal and inland waters, such as spills resulting from the operations of offshore supply vessels, pipelines, barges, tanker ships, and ports are more likely to affect BOEMRE-recognized infrastructure categories. For example, if waterways are closed to traffic, this may result in impacts to upstream and downstream business interests as it impedes the flow of commerce. **Table 3-7** contains the estimated number of oil spills that could happen in Gulf coastal waters as a result of an accidental event associated with the WPA proposed action.

Vessel collisions may be associated with exploration, production, or transportation activities that result from the WPA proposed action. Chapter 4.3.3 of the Multisale EIS provides a detailed discussion of vessel collisions. The BOEMRE data show that, from 1996 through 2005, there were 129 OCS-related collisions. The majority of vessel collisions involve service vessels colliding with platforms or pipeline risers, although sometimes vessels collide with each other. These collisions often result in spills of various substances and, while most occur on the OCS far from shore, collisions in coastal waters can have consequences to land use and coastal infrastructure. For example, on July 23, 2008, a barge carrying heavy fuel collided with a tanker ship in the Mississippi River at New Orleans, Louisiana. Over several days, the barge leaked an estimated 419,000 gallons of fuel. From New Orleans to the south, 85 mi (137 km) of the river were closed to all traffic while cleanup efforts were undertaken, causing a substantial backup of river traffic (USDOC, NOAA, 2008c). A more recent event involved an oil tanker and towing vessel pushing two barges that collided January 23, 2010, in the Sabine Neches Waterway near Port Arthur, Texas. The lead barge tore a hole in the side of the tanker, spilling approximately 450,000 gallons of crude oil in the Port of Port Arthur area (Gonzales and Manik, 2010). The waterway was closed to traffic for several days. One of four major refineries in the area significantly scaled back production until the waterway was reopened to limited traffic January 27, 2010 (Seba, 2010). While neither event involved OCS-related transportation and while both caused unusually large spills, they are examples of the types of accidental spills most likely to affect land use and infrastructure.

Chemical and drilling-fluid spills may be associated with exploration, production, or transportation activities that result from the WPA proposed action. Chapter 4.3.4 of the Multisale EIS provides a detailed discussion of chemical and drilling-fluid spills. Each year, between 5 and 15 chemical spills are expected to occur; most of these are ≤50 bbl in size. Large spills are much less frequent. For example, from 1964 to 2005, only two chemical spills of ≥1,000 bbl occurred. Even though additional production chemicals are needed in deepwater operations where hydrate formation is a possibility, spill volumes are expected to remain stable because of advances in subsea processing.

With the exception of a catastrophic accidental event, such as the DWH event, the impact of oil spills, vessel collisions, and chemical/drilling fluid spills are not likely to last long enough to adversely affect overall land use or coastal infrastructure in the analysis area.

Deepwater Horizon Event

While it is too early to determine the final outcome and impacts of the DWH event, information is gradually becoming available, particularly on short-term impacts. Although available evidence indicates that the DWH event resulted in only limited direct impacts, if any, on land use and infrastructure in the WPA, the event could be instructive for what impacts may result in the event of another catastrophic spill should it reach the WPA. In the months following the DWH event, there have been some short-term, indirect impacts on land use and coastal infrastructure caused by the drilling suspension imposed on July 12, 2010, and lifted on October 12, 2010; by its lingering effects; and from changes in Federal requirements for drilling safety and the permit approval process. Drilling has resumed in shallow waters but must meet new drilling application information requirements as clarified in NTL 2010-N06. Deepwater drilling has commenced and is dependent upon operators fulfilling new more stringent requirements and BOEMRE permit approvals. The impacts of the suspension were experienced at Port Fourchon, Louisiana, where rental rates were cut by 30 percent as an incentive for businesses to stay. However, companies have removed a large portion of their equipment from the port and there has been a substantial decrease in helicopter flights and servicing of rigs. Many companies have had to trim their budgets by cutting hours and salaries. Support services companies, such as chemical suppliers, and welders have also been affected (Lohr, 2010).

The deepwater exploration activity at Port Fourchon is expected to resume with the approvals of deepwater permits. The rate of drilling is dependent upon compliance with more stringent Federal enforcement and the industry's efforts to fulfill new safety requirements. Deepwater exploratory drilling is a huge economic driver for jobs, investments, vessels, etc. (Chaisson, official communication, 2010). In the long term, the effects of the suspension and its aftermath are not expected to change the basic market fundamentals that drive demand for support infrastructure. In the short term, the decrease in deepwater exploratory drilling is expected to ripple through the various infrastructure categories (e.g., fabrication yard, shipyards, port facilities, pipecoating facilities, gas processing facilities, waste management facilities, etc.) and would also affect the oil and gas support sector businesses (e.g., drilling contractors, offshore support vessels, helicopter hubs, mud/drilling fluid/lubricant suppliers, etc.). See **Chapter 4.1.1.18.3** for a detailed analysis of economic factors. The BOEMRE will continue to monitor these infrastructure effects as they evolve over time.

Land use experienced more immediate, short-term impacts from the establishment of temporary waste staging areas and decontamination areas set up to handle spill-related waste. Concerns about waste management practices were expressed by government and the public (Barringer, 2010). The USEPA, in consultation with the Coast Guard, issued solid waste management directives to address the issue of contaminated materials and solid or liquid wastes that were recovered as a result to cleanup operations (USEPA, 2010f and 2010g). Fifteen waste staging areas spread out across Louisiana, and there were, no waste staging areas in Texas. No decontamination areas were set up in either Louisiana or Texas. The USEPA visited each staging and decontamination area once per week and each landfill two times per month, and they documented their findings on the USEPA public website. There were some issues, but nothing that would appear to cause a long-term impact (USEPA, 2010h). Additional description of the DWH event's waste stream is located in **Chapter 4.1.1.18.4**. Detailed analysis of a high-impact, low-probability catastrophic event such as the DWH event may be found in **Appendix B**.

Summary and Conclusion

Accidental events associated with the WPA proposed action occur at different levels of severity, based in part on the location and size of event. The typical types of accidental events that could affect land use and coastal infrastructure include oil spills, vessel collisions, and chemical/drilling-fluid spills. These may occur anywhere across the spectrum of severity. Typically, accidental events related to OCS activities are generally smaller in scale based on historic experience, and they must be distinguished from low-probability, high-impact catastrophic events such as DWH. Typically, the impact of small-scale oil spills, vessel collisions, and chemical/drilling fluid spills are not likely to last long enough to adversely affect overall land use or coastal infrastructure in the analysis area.

Many of the impacts of the DWH event to land use and infrastructure have been temporary and short-term, such as the ship decontamination sites and the waste staging areas established in the immediate aftermath of the DWH event (USDOT, 2010). The indirect effects on infrastructure use are still rippling through the industry, but this should resolve as issues with the moratorium, permitting, etc. are resolved. With regards to land use and infrastructure, the post-DWH event environment remains somewhat dynamic, and the BOEMRE will continue to monitor these resources over time and to document short- and long-term DWH event impacts. In the future, the long-term impacts of the DWH event will be clearer as time allows the production of peer-reviewed research and targeted studies that determine those impacts. The DWH event was a low-probability, high-impact catastrophic event. For the reasons set forth in the analysis above, the kinds of accidental events that are likely to result from proposed WPA Lease Sale 218 are not likely to significantly affect land use and coastal infrastructure. This is because accidental events offshore would have a small probability of impacting onshore resources. Also, if an accident occurs near shore, it would be most probably be near a facility; therefore, the impacts would be temporary and localized because of the decrease in response time.

4.1.1.18.1.4. Cumulative Impacts

Background/Introduction

A detailed analysis of cumulative impacts upon land use and coastal infrastructure for the WPA proposed action can be found in Chapter 4.5.15.1 of the Multisale EIS. Impact analyses for the 181 South Area that includes any new information since publication of the Multisale EIS is presented in Chapter 4.1.16.1.4 of the 2009-2012 Supplemental EIS. The following information is a summary of the impact analysis incorporated from the Multisale EIS the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The cumulative analysis considers the effects of impact-producing factors from OCS and State oil and gas activities. The OCS- and State-related factors consist of prior, current, and future OCS and State lease sales. Chapters 3.3.5.1.2 and 3.3.5.8 of the Multisale EIS discuss land use and OCS-related oil and gas infrastructure associated with the analysis area. The vast majority of this infrastructure also supports oil and gas production in State waters as well as in coastal areas onshore.

According to BOEMRE development scenario analysis, the construction of 0-1 new gas processing facilities would be expected to occur near the end of the 40-year life of a single lease sale. Most new pipelines would be offshore and would tie into the existing offshore pipeline infrastructure. According to the scenario analysis, 0-1 new pipeline landfalls would be expected to occur toward the end of the 40-year lifespan of the proposed lease sale. Those projections also called for no new waste disposal facilities due to existing excess capacity along the Gulf Coast. Recently, based on the analysis of historical data, BOEMRE validated its past scenario projections of new gas processing facilities and new pipeline landfalls and found its projections to be conservative; that is, the actual numbers proved to be equal to, or less than, the projected numbers. Current scenario projects are also likely to be conservative (Dismukes, official communication, 2010a).

In the months following the DWH event, much information has been generated regarding the consequences of the oil spill and subsequent drilling suspension. Because petroleum activities on the OCS and in State waters and coastal areas are driven by market fundamentals, the DWH event and related events are not expected to have long-term consequences on them. Hence, these events are not expected to affect land use and infrastructure in the cumulative case. However, because the post-DWH event environment is dynamic and ever-changing, BOEMRE is currently conducting ongoing monitoring of post-DWH event impacts to land use and coastal infrastructure, and BOEMRE will conduct targeted and peer-reviewed research should this monitoring identify long-term impacts of concern.

Land use in the analysis area will evolve over time. The majority of change is likely to occur from general, regional economic and demographic growth rather than from activities associated with current OCS and/or State offshore petroleum production or future planned OCS or State lease sales. Projected new coastal infrastructure as a result of the OCS Program is shown by State in Table 4-9 of the Multisale EIS. The BOEMRE development scenarios consider demand from both current and future OCS and State leases. These scenarios project 0-1 new gas processing facilities to result from an individual proposed action (i.e., a single OCS lease sale). However, this number is derived from the estimated demand for future processing capacity. Given current industry practice, it is likely that few (if any) new, greenfield gas processing facilities would actually be constructed along the WPA. Instead, it is likely that a large share (and possibly all) of any additional natural gas processing capacity that is needed in the industry would be developed at existing facilities, through future investments in expansions, and/or replacement of depreciated capital equipment. Also, these BOEMRE scenario projections are conservative; that is, they likely overestimate the additional capacity that would be required.

Over the past 5 years, there has been a substantial decrease in offshore natural gas production, partially as a result of increasing emphasis on onshore shale gas development, which is less expensive to produce and provides larger per-well production opportunities and reserve growth. Also, there has been a trend toward more efficient gas processing facilities with greater processing capacities (Dismukes, in preparation-a). For example, in Texas the average daily processing capacity per plant has increased from 66 MMcf to 95 MMcf between 1992 and 2006 (USDOE, Energy Information Administration, 2006). While natural gas production on the OCS shelf (shallow water) has been rapidly declining, deepwater gas production has been increasing, but not quickly enough to make up the difference. Increasing onshore shale gas development, declining offshore gas production, and the increasing efficiency and capacity of existing gas processing facilities are trends that have combined to lower the need for new gas processing facilities along the Gulf Coast in the past 5 years. Combined with this, existing facilities that were already operating at about 50 percent of capacity prior to the 2005 hurricane season are operating at even lower capacity utilization levels now. Spare capacity at existing facilities should be sufficient to satisfy new gas production for many years, although there remains a slim chance that a new gas processing facility may be needed by the end of the 40-year life of the proposed action (Dismukes, official communication, 2010c). Any additions to, or expansions of, current facilities would also support State oil and gas production and, should any occur, the land in the analysis area is sufficient to handle development. Thus, the results of OCS and State oil and gas activities are expected to minimally alter the current land use of the area.

Service-base infrastructure supports offshore petroleum-related activities in both OCS and State waters. Any changes to offshore support infrastructure that occurs in the cumulative case are expected to be contained on available land. Service bases are industrial ports and are located in designated industrial parks designed with the intent to accommodate future oil and gas needs. Also, most of these are located in BOEMRE analysis areas that have strong industrial bases. Shore-based OCS and State servicing is expected to increase in the ports of Galveston, Texas; Port Fourchon, Louisiana; and Mobile, Alabama. There is sufficient land designated in commercial and industrial parks and adjacent to the Galveston and Mobile port areas. This would minimize disruption possible from port expansions to current residential and business use patterns. In contrast, while Port Fourchon has land designated for future expansion, the port has a limited amount of waterfront land available and, because of surrounding wetlands, may face capacity constraints in the long term. At present, there is a small amount of waterfront property available that is situated around Slip C (The Greater Lafourche Port Commission, 2010a) and approximately 55 ac

(22 ha) of nonwaterfront property also available for lease (The Greater Lafourche Port Commission, 2010b). The port's 4,000-ac (1,620-ha) Northern Expansion is nearly complete and will essentially double its operational area. Phase 1 of the Northern Expansion is a 700-ac (284-ha) site containing 520 ac (210 ha), with 21,000 ft (6,400 m) of water frontage. Construction of 700 ft (213 m) of bulkhead in Slip B is complete, and an additional 1,100 ft (335 m) of bulkhead is currently under construction. Another 1,425 ft (434 m) of bulkhead is scheduled for construction in 2010. Phase 1 of the Northern Expansion is nearly complete, and over 80 percent of total Phase 1 property is already leased (The Greater Lafourche Port Commission, 2010c). Port Fourchon serves as the primary support base for over 90 percent of existing deepwater projects. From 2008 through 2009, the demand for support base facilities continued to increase despite an economic recession. Prior to the DWH event, new facilities at the port were leased as soon as they could be constructed (Redden, 2009).

In the months following the DWH event and the May 2010 drilling suspension, port tenants were struggling with the drop in exploration drilling. Even after the drilling suspension was lifted on October 12, 2010, activity levels remained depressed. This was due to more stringent Federal enforcement, industry's efforts to fulfill new safety requirements, and the current pace for drilling application approvals. Cleanup and decontamination work was keeping companies busy, but this has been gradually declining, with the exception of continued clean up at Fourchon Beach, which has been slowed down by piping plover nesting. Deepwater exploratory drilling is a huge economic driver for jobs, investments, vessels, etc. at Port Fourchon (Chaisson, official communication, 2011). There has been much uncertainty about what is going to happen at Port Fourchon from an economic standpoint. However, BOEMRE expects this uncertainty to be short term and, because the economic prospectivity of the Gulf has not changed, deepwater activity at the port will be expected to gradually increase to pre-DWH event levels.

Louisiana Highway 1 (LA Hwy 1) is the only highway connecting Port Fourchon with the rest of Louisiana. This two-lane highway is surrounded by marshland and has been prone to extreme flooding over the years, jeopardizing critical access to Port Fourchon, which is the service base for 90 percent of OCS deepwater activity. While, in the absence of planned expansions, LA Hwy 1 would not be able to handle future OCS and State activities, a multiphase LA Hwy 1 improvement project is currently underway. On July 8, 2009, the new LA Hwy 1 fixed-span toll bridge over Bayou Lafourche connecting Port Fourchon and Leeville, Louisiana, was opened and marks partial completion of the first phase of improvements to LA Hwy 1 (*Toll Roads News*, 2009). A large portion of the tolls collected will be paid by transportation activities associated with OCS oil- and gas-related activities. The remaining portion of Phase 1 construction, a two-lane elevated highway from the bridge to Port Fourchon, is scheduled for completion in late 2011. There are continuing efforts to get Federal funding to construct Phase 2 of the project—an elevated highway from the Golden Meadow floodgates to Leeville, Louisiana (LA 1 Coalition, 2010a).

The South Lafourche Leonard Miller Jr. Airport recently opened a partial parallel taxiway and the Port Commission has plans to extend it to full length. In the past 8 years, $20 million has been invested in the airport for improvements that include the paving of airport roadways, runway expansion and overlay, installation of fuel tanks, and construction of an extra large hanger. The runway expansion and overlay have increased the maximum aircraft weight to allow access for 20-passenger jets. From 2008 to 2009, activity at the airport increased 19 percent. Airport authorities are also in the second phase of implementing an Instrument Landing System like those found at major commercial airports as a navigational aid to pilots. The Greater Lafourche Port Commission recently acquired 1,200 ac (485 ha) of property near the airport and intends to develop that land into an industrial park (The Greater Lafourche Port Commission, 2010d).

If the service base expansion occurs in the cumulative case at the ports of Galveston, Texas, and Mobile, Alabama, this expansion would occur in areas that are already industrialized and would have little effect on land use and infrastructure. This is also true for Port Fourchon, Louisiana, although, in the cumulative case, expansion of this service base may eventually be constrained by surrounding wetlands. Limited highway access and airport capacity could also constrain service base expansion at Port Fourchon in the cumulative case. However, ongoing and planned improvement projects make this unlikely.

Summary and Conclusion

Activities relating to the OCS Program and State oil and gas production are expected to minimally affect the current land use of the analysis area because most subareas have strong industrial bases and designated industrial parks to accommodate future growth in oil and gas businesses. The BOEMRE projects 0-1 new gas processing facilities and 0-1 new pipeline landfalls for a single sale, although this is a conservative estimate and the number is much closer to zero than to one. If a new gas processing facility or pipeline landfall were to occur, it would likely be toward the end of the 40-year analysis period (Dismukes, official communication, 2010c). There may be new increase demand for a waste disposal services as a result of the proposed action. Any service base expansion in the cumulative case would be limited, would occur on lands designated for such purposes, and would have minimal effects on land use and infrastructure. However, in the cumulative case, it is possible that Port Fourchon expansions may eventually be constrained by surrounding wetlands. Based on the available information and current BOEMRE scenario projections, the cumulative impacts on land use and coastal infrastructure are expected to be minor. The incremental contribution of the WPA proposed action to the cumulative impacts on land use and coastal infrastructure are also expected to be minor in comparison to other non-OCS-related factors, given that the coastal infrastructure supporting the proposed action represents only a tiny portion of the coastal land and infrastructure throughout the WPA and GOM generally.

4.1.1.18.2. Demographics

In light of the recent DWH event, BOEMRE has reexamined the analysis of demographics presented in the Multisale EIS and the 2009-2012 Supplemental EIS. While some new information was found related to the baseline conditions (most notably the new Woods & Poole Economics, Inc. (2010) population projection data), the incremental population impacts of proposed WPA Lease Sale 218, and the impacts of accidental events, a reanalysis found that none of the new information altered the impact conclusions for demographics presented in the Multisale EIS and the 2009-2012 Supplemental EIS. While it is too early to determine if there will be any significant long-term demographic changes as a result of the DWH event and the subsequent drilling suspension and given current information on the limited employment impacts to date (**Chapters 4.1.1.14, 4.1.1.15, 4.1.1.16, and 4.1.1.18.3**), BOEMRE anticipates that there will not be any substantial long-term population and demographic changes. However, BOEMRE will continue to monitor data and information as it becomes available. If there are substantial, long-term employment impacts to the tourism and recreation, fishing, or energy industries in the area, there may be some out-migration from some affected areas in the region.

A detailed description of the affected environment and full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action are presented in the Multisale EIS and the 2009-2012 Supplemental EIS, as are the proposed action's incremental contribution to the cumulative impacts. A summary of those analyses and their reexamination due to new information and the DWH event and drilling suspension are presented in the following sections.

A brief summary of potential impacts follows. The WPA proposed action is projected to minimally affect the demography of the analysis area. Population impacts from proposed WPA Lease Sale 218 are projected to be minimal (<1% of the total population) for any EIA in the Gulf of Mexico region. The baseline population patterns and distributions projected and described in **Chapter 4.1.1.18.2.1** below are expected to remain unchanged as a result of proposed WPA Lease Sale 218. The increase in employment discussed in **Chapter 4.1.1.18.3.2** is expected to be met primarily with the existing population and available labor force, with the exception of limited in-migration (some possibly foreign) projected for focal areas such as Port Fourchon. Accidental events associated with the proposed action, such as oil or chemical spills, blowouts, and vessel collisions, would likely have no effects on the demographic characteristics of the Gulf Coast communities. The cumulative activities are projected to minimally affect the analysis area's demography.

4.1.1.18.2.1. Description of the Affected Environment

The description of the environment for demographics is described in Chapter 3.3.5.4 of the Multisale EIS and in Chapter 4.1.16.2.1 of the 2009-2012 Supplemental EIS. The following is a summary and update of the information presented in those documents. A search was conducted for new information since completion of the 2009-2012 Supplemental EIS that would impact the baseline demographics of the region. The BOEMRE examines demographic impacts over the 40-year life of the proposed action. The new *The 2011 Complete Economic and Demographic Data Source* (CEDDS) from Woods & Poole Economics, Inc. (2010) was most relevant to this examination, and the BOEMRE updated all baseline projections using these data. The limited supplemental information related to the short-term employment and demographic impacts of the DWH event and the drilling suspension that is available is presented at the end of this section. However, this supplemental information does not change the Woods & Poole Economics, Inc. baseline population projections used to analyze impacts of proposed WPA Lease Sale 218 and the OCS Program, which, as explained in **Chapter 4.1.1.18.2.4**, is used for the cumulative impact analysis. The methodology BOEMRE uses to measure employment impacts (and the subsequent demographic impacts that are generated by employment changes) over the 40-year life of the proposed lease sale recognizes that most of the employment that results from industry activities that result from the lease sale is not generated until 4-7 years after the sale. In contrast, the supplemental information provided below is related to current socioeconomic conditions.

Offshore waters of the WPA, CPA, and EPA lie adjacent to coastal Texas, Louisiana, Mississippi, Alabama, and Florida. The BOEMRE groups sets of counties and, in Louisiana, parishes into LMA's on the basis of intercounty commuting patterns. Twenty-three of these LMA's span the Gulf Coast and comprise the 13 BOEMRE-defined EIA's. **Table 4-25** lists the counties and parishes that comprise the LMA's and EIA's, and **Figure 2-2** illustrates the counties and parishes that comprise the EIA's; see Chapter 3.3.5.4.1 of the Multisale EIS for further detail. The nature of the offshore oil and gas industry is such that the same onshore impact area is used to examine leasing activities in both the WPA and CPA. First, workers commute long distances for rotations offshore that last for 2-3 weeks at a time, and there is great flexibility between where employees live in the region and where they work offshore in the GOM. Second, industry equipment and supplies for offshore projects in both planning areas come from throughout the region. Although the same overall onshore impact area is used to analyze sales in both planning areas, the impacts to the different individual EIA's do vary between WPA sales and CPA sales.

Tables 3-18 through 3-30 of the Multisale EIS provide projections of detailed demographic data for the EIA's using 2006 CEDDS data (Woods & Poole Economics, Inc., 2006). **Tables 4-26 through 4-38** provide updated projections of the data using the 2011 CEDDS data (Woods & Poole Economics, Inc., 2010). These projections assume the continuation of existing social, economic, and technological trends at the time of the forecast. Therefore, the projections include employment associated with the OCS leasing patterns and other industry trends that were prevalent prior to the DWH event and the subsequent drilling suspension. However, these data still remain the best long-term forecast of regional trends for socioeconomic impact analyses of proposed WPA Lease Sale 218. The EIA's total population increased by 6 percent between 2005 and 2010, to approximately 24.5 million. In the U.S., population age structures typically reflect the presence of the baby-boom generation. In the EIA's, the largest increases from 2005 to 2010 were in the Age 50 to 64 and Age 65 and Over categories, which grew by 16 percent and 10 percent, respectively. In the EIA's, the Hispanic population increased 17.2 percent between 2005 and 2010. This group is the second largest race/ethnic group in the area, making up 27.8 percent of the area's population in 2010. The total African-American population increased 5.2 percent between 2005 and 2010. Although Asians and Pacific Islanders constitute a relatively small portion of the Gulf Coast population (3.1%), this group has experienced a growth rate of 19.5 percent between 2005 and 2010. The proportion of white population has remained fairly constant and in 2010 constitutes 51.4 percent of the area's population. These overall trends vary from one EIA to another and from one Gulf Coast State to another.

Differences in age structure, as well as net migration, among the coastal EIA's could create variations in population growth. The highest rates of population growth between 2010 and 2040 are expected in Texas EIA's (TX-1 at 63%) and Florida EIA's (FL-1 at 54.4%), and the lowest are expected in Alabama, Mississippi, and Louisiana EIA's (LA-1 is the lowest at 18.3%).

The racial and ethnic composition of the analysis area reflects both historical settlement patterns and current economic activities. For example, those areas in Texas where Hispanics are the dominant group—EIA TX-1 where they represent 81 percent of the population—were also first settled by people from Mexico. Their descendants remain, many of whom work in farming, tending cattle, or in low-wage industrial jobs. By TX-3, the size of the African-American population increases, and there is a more diversified racial mix, indicating more urban and diverse economic pursuits. In Louisiana, Mississippi, Alabama, and Northern Florida (FL-1 and FL-2), African-Americans outnumber Hispanics, reflecting the dominant minority status of African-Americans throughout much of the analysis area. A more detailed discussion of minority populations in the area can be found in **Chapter 4.1.1.18.4.1**.

Table 4-39 presents the baseline population projections used to analyze the impacts of proposed WPA Lease Sale 218 and the OCS Program (which, as explained in **Chapter 4.1.1.18.2.4** is used for the cumulative impact analysis). As stated above, these baseline projections assume, over the long-term, the continuation of existing social, economic, and technological trends at the time of the forecast (i.e., prior to the DWH event and the subsequent drilling suspensions). However, this data still remain the best long-term forecast of regional trends for socioeconomic impact analyses of proposed WPA Lease Sale 218.

4.1.1.18.2.2. Impacts of Routine Events

Background/Introduction

A detailed description of routine impacts on demographics associated with the WPA proposed action can be found in Chapter 4.2.1.1.13.2 of the Multisale EIS and in Chapter 4.1.16.2 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in these documents and incorporates new information found since their publication.

The addition of any new human activity, such as oil and gas development resulting from the WPA proposed action, can affect local communities in a variety of ways. Typically, these effects are in the form of people and money, which can translate into changes in the local social and economic institutions. Minor demographic changes, primarily in focus areas, are projected as a result of the WPA proposed action.

Proposed Action Analysis

Population

Projected population changes reflect the number of people dependent on income from OCS-related employment for their livelihood (i.e., family members of oil and gas workers). The population projections due to proposed Lease Sale 218 are calculated by multiplying the employment projections for the sale (**Chapter 4.1.1.18.3.2**) by a ratio of baseline population to baseline employment (**Tables 4-39 and 4-40**). Proposed WPA Lease Sale 218 is projected to generate from 4,200 to 8,400 persons in the entire analysis area during the peak impact year (model year 5 or 2016) for the low- and high-case scenarios, respectively. While population associated with the proposed sale is projected to peak in year 5, years 2 and 6 also display high levels. During these years, a substantial amount of platform and pipeline installations are projected in association with the proposed sale. Platform fabrication and installation, and pipeline installation activities are labor intensive and tend to occur concurrently, leading to more substantial employment and population impacts.

Using the new Woods & Poole Economics, Inc. data discussed above as the baseline, BOEMRE recalculated the population impacts on a percentage basis. The revised numbers do not differ substantially from those presented in Table 4-21 of the Multisale EIS and mirror those for employment impacts discussed in **Chapter 4.1.1.18.3.2**. Population impacts from proposed WPA Lease Sale 218 are expected to be minimal (less than 1% of total population) for any EIA in the Gulf of Mexico region. Job creation is analyzed in **Chapter 4.1.1.18.3.2**. The identified increase in employment is expected to be met primarily with the existing population and labor force, and it would not significantly impact the population, with the possible exception of some in-migration projected to move into such focal areas as Port Fourchon.

Age

The age distribution of the analysis area as a result of proposed WPA Lease Sale 218 is projected to remain virtually unchanged. Given both the low levels of population growth and industrial expansion associated with the proposed action, the age distribution pattern discussed above in **Chapter 4.1.1.18.2.1** is expected to continue through the life of the WPA proposed action. Proposed WPA Lease Sale 218 is not expected to affect the analysis area's median age.

Race and Ethnic Composition

The racial distribution of the analysis area is projected to remain virtually unchanged as a result of proposed WPA Lease Sale 218. Given the low levels of employment and population growth and the industrial expansion projected as a result of the proposed action, the racial distribution pattern described above in **Chapter 4.1.1.18.2.1** is expected to continue through the life of the WPA proposed action.

Summary and Conclusion

Proposed WPA Lease Sale 218 is projected to minimally affect the demography of the analysis area. Population impacts from the proposed action are projected to be minimal (<1% of the total population) for any EIA in the Gulf of Mexico region. The baseline population patterns and distributions, as projected and described in **Chapter 4.1.1.18.2.1**, are expected to remain unchanged as a result of proposed WPA Lease Sale 218. The increase in employment is expected to be met primarily with the existing population and available labor force, with the exception of some in-migration projected to occur in focal areas, such as Port Fourchon.

4.1.1.18.2.3. Impacts of Accidental Events

Accidental events may cause short-term population movements as individuals seek employment related to the event or have their existing employment displaced during the event. Such population movements are relatively small and short term. Therefore, accidental events associated with proposed WPA Lease Sale 218, such as oil or chemical spills, blowouts, and vessel collisions, would likely have no effects on the demographic characteristics of the Gulf coastal communities. This is because net employment impacts from a spill are not expected to exceed 1 percent of baseline employment for any EIA in any given year, even if they are included with employment associated with routine oil and gas development activities associated with the WPA proposed action, and population changes are derived from employment changes.

In the case of a catastrophic spill, there may be some out-migration from some affected areas in the region if there are substantial long-term employment impacts to the tourism and recreation, fishing, or energy industries in the area. For further discussion on the employment and demographic impacts of a catastrophic spill, see **Appendix B**.

Summary and Conclusion

Accidental events may cause short-term population movements, but they would not be expected to affect demographic characteristics as a whole in the affected area.

4.1.1.18.2.4. Cumulative Impacts

Background/Introduction

A detailed discussion of the cumulative impacts to demographics can be found in Chapter 4.5.15.2 of the Multisale EIS and in Chapter 4.1.16.2.4 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in these documents and incorporates new information found since their publication. The cumulative analysis considers the effects of OCS-related, impact-producing factors as well as non-OCS-related factors on demographics. The OCS-related factors consist of population and employment from prior, current, and future OCS lease sales. Non-OCS factors include fluctuations in workforce, net migration, relative income, oil and gas activity in State waters, and offshore LNG activity. Not considered in this analysis are the unexpected events that may influence oil and gas activity within the analysis area that cannot be predicted with reasonable accuracy. Examples of unexpected events include oil embargos and acts or war or terrorism.

Most approaches to analyzing cumulative effects begin by assembling a list of "other likely projects and actions" to be included with the proposed action analysis. However, no such list of future projects and actions could be assembled that would be sufficiently current and comprehensive to support a cumulative analysis for all 132 of the coastal counties and parishes in the analysis area over a 40-year period. Instead, this analysis uses the economic and demographic projections from Woods & Poole

Economics, Inc. (2010) as a reasonable approximation to define the contributions of other likely projects, actions, and trends to the cumulative case. These projections include population associated with the continuation of current patterns of OCS leasing activity as well as the continuation of trends in other industries important to the region. The same methodology used to project changes to population from routine activities associated with proposed WPA Lease Sale 218 is used to examine impacts of the OCS Program in the region.

Population

Population impacts from the OCS Program (Table 4-43 in the Multisale EIS) remain unchanged because the exploration and development scenarios for the OCS Program did not change for this document (and thus the employment projections related to the OCS Program did not change). Projected population changes reflect the number of people dependent on income from oil- and gas-related employment for their livelihood (i.e., family members of oil and gas workers). Activities associated with the OCS Program are projected to have minimal effects on population in most of the EIA's. Lafourche Parish (EIA LA-3) and Lafayette Parish (EIA LA-2) in Louisiana, in particular, are projected to experience noteworthy increases in population resulting from increases in demand for OCS labor. Chapter 4.5.15.3 of the Multisale EIS discusses this issue in more detail.

Using the new Woods & Poole Economics, Inc. data (2010) discussed above as the baseline, BOEMRE recalculated the population impacts of the OCS Program on a percentage basis. These revised numbers do not differ substantially from those presented in Table 4-44 of the Multisale EIS and mirror those discussed for OCS Program employment in **Chapter 4.1.1.18.3.4**.

Age

Cumulative activities are projected to leave the age distribution of the analysis area virtually unchanged. Given both the low levels of population growth and the industrial expansion associated with the cumulative activities, it is projected that the age distribution pattern discussed above in **Chapter 4.1.1.18.2.1** would likely continue throughout the analysis period.

Race and Ethnic Composition

Cumulative activities are projected to leave the racial distribution of the analysis area virtually unchanged. Given the low levels of employment and population growth and the industrial expansion projected for the cumulative activities, the racial distribution pattern discussed above in **Chapter 4.1.1.18.2.1** is projected to continue throughout the analysis period.

Summary and Conclusion

The cumulative activities are projected to minimally affect the analysis area's demography. Baseline patterns and distributions of these factors, as described in **Chapter 4.1.1.18.2.1**, are not expected to change for the analysis area as a whole. Lafourche Parish (EIA LA-3), including Port Fourchon, and Lafayette Parish (EIA LA-2) in Louisiana are projected to experience noteworthy impacts to population as a result of an increase in demand for OCS labor from the OCS Program. Proposed WPA Lease Sale 218 is projected to have an incremental contribution of less than 1 percent to the population level in any of the EIA's, in comparison to other factors influencing population growth, such as the status of the overall economy, fluctuations in workforce, net migration, and changes in income. Given both the low levels of population growth and industrial expansion associated with the proposed action, it is expected that the baseline age and racial distribution pattern would continue through the analysis period.

4.1.1.18.3. Economic Factors

In light of the recent DWH event, BOEMRE has reexamined the analysis of economic factors presented in the Multisale EIS and the 2009-2012 Supplemental EIS. While some new information was found related to the baseline employment conditions (most notably the new Woods & Poole Economics, Inc. (2010) data on projections for employment), the incremental employment impacts of proposed WPA

Lease Sale 218, and the impacts of accidental events, a reanalysis found that none of the new information altered the impact conclusions for employment presented in the Multisale EIS and the 2009-2012 Supplemental EIS. It is too early to determine if there will be any significant long-term employment changes in the region as a result of the DWH event and the subsequent drilling suspension. Given current information, BOEMRE anticipates that there may be some long-term employment changes in some counties and parishes in the region. However, at this time, it is not clear if these changes will be substantial or not. The BOEMRE will continue to monitor data and information on employment as it becomes available. Short-term employment impacts and potential long-term employment impacts related to the DWH event, in general, and the drilling suspension, in particular, are discussed at the end of the sections below on the "Description of the Affected Environment" (**Chapter 4.1.1.18.2.1**) and "Impacts of Accidental Events" (**Chapter 4.1.1.18.2.3**). The following sections focus on the employment impacts to the energy industries and offshore support industries in the BOEMRE-defined EIA's. The employment impacts to commercial fishing (**Chapter 4.1.1.14**), recreational fishing (**Chapter 4.1.1.15**), and tourism and recreation (**Chapter 4.1.1.16**) are discussed in detail within their individual sections.

A detailed description of the affected environment and full analyses of the potential impacts of routine activities and accidental events associated with the WPA proposed action are presented in the Multisale EIS and the 2009-2012 Supplemental EIS, as are the proposed action's incremental contribution to the cumulative impacts. A summary of those analyses and their reexamination due to new information and the DWH event and drilling suspension are presented in the following sections.

A brief summary of potential impacts follows. Should the proposed WPA lease sale occur, there would be only minor economic changes in the Texas, Louisiana, Mississippi, Alabama, and Florida EIA's. The proposed action in expected to generate less than a 1 percent increase in employment in any of the coastal subareas, even when the net employment impacts from accidental events are included. Most of the employment related to the proposed action is expected to occur in Texas and Louisiana. The labor demand would be met primarily with the existing population and labor force. The cumulative activities are projected to minimally affect the analysis area's economic conditions.

4.1.1.18.3.1. Description of the Affected Environment

Chapter 3.3.5.5 of the Multisale EIS describes the economic factors relevant to the socioeconomic analysis area, including measures of employment (Chapter 3.3.5.5.1), income and wealth (Chapter 3.3.5.5.2), and business patterns by industrial sector (Chapter 3.3.5.5.3). Additional information, particularly as it relates the impacts of the 2005 hurricane season, can be found in Chapter 4.1.16.3.1 of the 2009-2012 Supplemental EIS. The following is a summary and update of the information presented in those documents. A search was conducted for new information since completion of the Supplemental EIS that would impact the baseline economic factors of the region. The BOEMRE examines economic impacts over the 40-year life of the proposed action. The new 2011 CEDDS data from Woods & Poole Economics, Inc. (2010) was most relevant to this examination, and BOEMRE updated all baseline projections using these data. The limited supplemental information related to the short-term impacts of the DWH event and the drilling suspension that is available is presented at the end of this section. However, this supplemental information does not change the Woods & Poole Economics, Inc. baseline employment projections used to analyze the impacts of proposed WPA Lease Sale 218 and the OCS Program, which, as explained in **Chapter 4.1.1.18.3.4**, is used for the cumulative impact analysis. The methodology BOEMRE uses to measure employment impacts (and subsequent demographic impacts) over the 40-year life of the proposed lease sale recognizes that most of the employment that results from industry activities that result from the lease sale is not generated until 4-7 years after the sale. In contrast, the supplemental information provided below is related to current socioeconomic conditions.

Offshore waters of the WPA, CPA, and EPA lie adjacent to coastal Texas, Louisiana, Mississippi, Alabama, and Florida. The BOEMRE groups sets of counties and, in Louisiana, parishes into LMA's on the basis of intercounty commuting patterns. Twenty-three of these LMA's span the Gulf Coast and comprise the 13 BOEMRE-defined EIA's. **Table 4-25** lists the counties and parishes that comprise the LMA's and EIA's, and **Figure 2-2** illustrates the counties and parishes that comprise the EIA's; see Chapter 3.3.5.4.1 of the Multisale EIS for further detail. The nature of the offshore oil and gas industry is such that the same onshore economic impact area is used to examine leasing activities in both the WPA and CPA. First, workers commute long distances for rotations offshore that last for 2-3 weeks at a time, and there is great flexibility between where employees live in the region and where they work offshore in the GOM. Second, industry equipment and supplies for offshore projects in both planning areas come from throughout the region. Although the same overall economic impact area is used to analyze sales in both planning areas, the economic impacts to the different individual EIA's do vary between WPA sales and CPA sales in terms of levels of employment for the individual states.

Tables 3-18 through 3-30 of the Multisale EIS provide current and baseline projections for employment, income and wealth, and business patterns for the EIA's using 2006 CEDDS data (Woods & Poole Economics, Inc., 2006). **Tables 4-26 through 4-38** provide updated projections of the data using the 2011 CEDDS data (Woods & Poole Economics, Inc., 2010). Average annual employment growth projected from 2010 to 2040 range from a low of 1.03 percent for EIA MS-1 to a high of 2.04 percent for EIA FL-1 in the western panhandle of Florida. Over the same time period, employment for the United States is expected to grow at about 1.39 percent per year, while the GOM economic impact analysis area as a whole is expected to grow at about 1.79 percent per year.

The Woods & Pool Wealth Index is a measure of relative wealth, with the U.S. having a value of 100. The Wealth Index is the weighted average of regional income per capita divided by U.S. income per capita (80% of the index), plus the regional proportion of income from dividends/interest/rent divided by the U.S. proportion (10% of the index), plus the U.S. proportion of income from transfers divided by the regional proportion (10% of the index). Thus, relative income per capita is weighted positively for a relatively high proportion of income from dividends, interest, and rent, and negatively for a relatively high proportion of income from transfer payments. In 2010, all EIA's within the GOM analysis area with the exception of FL-4 (which had an index of 113.4) ranked below the U.S. in terms of the Wealth Index. The next two highest EIA's were LA-4 and TX-3, with indices of 91.9 and 87.4, respectively. The EIA FL-2 ranked the lowest of all EIA's, with an index of 66.8. The Florida EIA's comprise the portion of the analysis area that is least influenced by OCS development. The EIA's with the next lowest wealth indices are AL-1 and MS-1, with indices of 71.9 and 73.6, respectively.

Of the 132 counties that comprise the GOM region's economic analysis area, 19 ranked above the U.S. (6 in FL-4; 4 in LA-4; 3 in TX-3; 2 in LA-1; and 1 in LA-2, TX-1, FL-1, and FL-3). Monroe County in FL-4 was the highest, with an index of 157.91. The lowest county is Starr County in TX-1 with an index of 42.12, followed by Greene County in MS-1 with 50.92 and Hamilton County in FL-2 with 51.76.

As shown in **Tables 4-26 through 4-38**, the industrial composition for the EIA's is similar. In 2010, all of the EIA's had State and Local Government and Retail Trade as one of their top five ranking sectors in terms of employment, and all of them except MS-1 had Health Care and Social Assistance as one of their top five. Accommodation and Food Services is one of the top five sectors for seven of the EIA's (TX-1, LA-1, LA-3, LA-4, MS-1, FL-1, and FL-2). As part of its economic impact analysis in **Chapter 4.1.1.18.3.2**, BOEMRE uses regional input-output multipliers from the commercial software IMPLAN. A set of multipliers is created for each EIA in the analysis area based on each EIA's unique industry make-up. An assessment of the change in overall economic activity for each EIA is then modeled as a result of the expected changes in economic activity associated with holding the proposed WPA lease sale.

Table 4-40 presents the baseline employment projections used to analyze the impacts of proposed WPA Lease Sale 218 and the OCS Program which, as explained in **Chapter 4.1.1.18.3.4**, is used for the cumulative impact analysis. These baseline projections assume the continuation of existing social, economic, and technological trends at the time of the forecast. Therefore, the projections include employment associated with the OCS leasing patterns and other industry trends that were prevalent prior to the DWH event and the subsequent drilling suspension. However, this data still remain the best long-term forecast of regional trends for socioeconomic impact analyses of proposed WPA Lease Sale 218.

Deepwater Horizon Event

Tracking the economic and employment impacts in the GOM region as a result of the DWH event will be a long-term and difficult task. Many of the potentially affected jobs, like fishing charters, are self-employed. Thus, they will not necessarily file for unemployment and will not be included in business establishment surveys used to estimate State unemployment levels. In addition, unemployment numbers in states are based on nonagricultural jobs, and the fishing industry is considered within the agriculture category. On the other side, it is also a challenge to estimate how many of these displaced workers have been hired to clean up the spill. Furthermore, the extent of the geographic areas that will be affected economically in the long term is unknown, as is how long the impacts will last (e.g., if fisheries are irreparably damaged, affected fishermen will have no jobs to go back to).

As a result of the DWH event, a drilling suspension extended from July 12, 2010, to October 12, 2010. The suspension had the effect of suspending activity at all 33 rigs developing exploratory wells in deep water. This posed new hardships for hundreds of oil-service companies that supply the steel tubing, engineering services, drilling crews, and marine-supply boats critical to offshore exploration. Early estimates varied concerning the potential economic and employment impacts of the suspension varied. David Dismukes of LSU's Center for Energy Studies estimated as many as 35,000 jobs could be affected (Hargreaves, 2010). The Louisiana Mid-Continent Oil and Gas Association estimated a total of 800-1,400 jobs per idle rig platform were at risk, or roughly 34,400-60,000 throughout the Gulf economy (Louisiana Mid-Continent Oil and Gas Association, 2010). The Louisiana Department of Economic Development estimated that, if the suspension of active drilling activity continued for an extended period, the State risked losing more than 20,000 existing and potential jobs over a 12- to 18-month period (Jindal, 2010). Lawrence R. Dickerson, the Chief Executive of Diamond Offshore Drilling, which owns six deepwater rigs in the Gulf, stated that 15,000-20,000 rig and associated service jobs were at risk during this period (Zeller, 2010).

Roubini Global Economics (Teslik and Menegatti, 2010) estimated that the economic consequences of the spill will lead to a net loss of just under $20 billion for the U.S. economy in 2010, which will lower U.S. economic growth in 2010 by roughly 0.1 percent and will lower growth in the four states most affected (Louisiana, Mississippi, Alabama, and Florida) by 1.6 percent of their combined gross domestic product. They estimated that the oil and gas industry was likely to suffer the most from the spill ($9 billion, including impacts of a deepwater drilling suspension and impacts to oil and gas support industries), followed by tourism ($8.4 billion regionwide, with Louisiana and Florida taking the biggest losses), and fishing ($1.2 billion). An economist at Wells Fargo estimated that up to 250,000 Gulf jobs in fishing, tourism, and energy would be lost in the second half of the year (Aversa, 2010). It was estimated that, in total, the new jobs in cleanup would not make up for what had been lost and would likely pay less (e.g., $15-18/hr compared to roughly $45/hr on a drilling rig), so consumers in the region would likely spend less as a result (Aversa, 2010). However, the degree to which new cleanup jobs offset job losses would vary greatly from county-to-county/parish-to-parish. As of July 6, 2010, more than 45,000 personnel were working on the response effort (RestoreTheGulf.gov, 2010d).

As more information became available, estimates of the impacts of the DWH event changed. An Inter-Agency Report on the economic effects of the deepwater drilling suspension on the Gulf Coast economy in September found that there had not been large increases in unemployment. Recipients of unemployment insurance in three states had been asked whether their claims were related to the suspension. Based on the responses through September 13, 2010, only 734 suspension-related continuing claims had been filed in Louisiana, 22 in Mississippi, and 64 in Texas (for a total of 820). As noted previously, however, self-employed persons are not eligible for unemployment insurance and are thus not reflected in the data. The report estimated that during the 6-month period an average of 2,000 rig workers would have been laid off or left the Gulf Coast, or about 20 percent of the rig workers employed in the GOM prior to the DWH event. The report also estimated that total operator spending on leasing vessels, supplies, services, and materials would be reduced by about $1.95 billion as a result of the suspension, affecting the network of onshore businesses that serve the deepwater drilling economy. Including multiplier impacts, the report estimated that up to 8,000-12,000 jobs may be temporarily lost, but that most would return following the resumption of deepwater drilling in the GOM. As stated, deepwater drilling has resumed and the pace of permit issuance will determine the rate at which these jobs become available.

The suspension was lifted on October 12, 2010, and new permits for deepwater drilling have been awarded. At the end of November, 27 jackups were actually working, only 5 of 25 semisubmersibles were working, and only 1 of 11 drillships were working (Greenberg, 2010). Day rates for large, deepwater, supply vessel operators dropped from an average $14,787 a day in October 2010 to $11,500 in March 2011, and utilization fell from 89 percent to 81 percent (Greenberg, 2011). In March 2011, Gulf rig activity was up a net five rigs, primarily due to jackup rigs going to work as more shallow-water drilling permits were issued. Rig utilization was at 56.5 percent (Greenberg, 2011). Deepwater drilling activity is expected to pick up as BOEMRE awarded deepwater drilling permits to eight operators during March 2011. As of December 2010, only three deepwater rigs had exited the Gulf since the deepwater suspension was implemented. However, the post-suspension delay in the resumption of operations was continuing, increasing the possibility that more rigs will leave the Gulf in the future. In addition, the offshore industry also continues to face compliance with new regulations and higher insurance costs, and these may potentially lead to lower levels of industry activity than prevailed prior to the DWH event. According to one annual study for Louisiana, Lafayette and Houma-Thibodaux face employment drops because of a projected slowdown in the Gulf oil and natural gas activity. The report projects a loss of 3,000 (2%) jobs in 2011 and another 800 (0.6%) in 2012 for Lafayette. Houma-Thibodaux is forecast to have a loss of 1,500 jobs (1.7%) in 2011 and another 500 (0.5%) in 2012 (Sayre, 2010). The report also warns that the planned closing of the Northrop Grumman Corp. shipyard in suburban Avondale, which currently employs about 4,400, will be felt in early 2013 in the New Orleans area (Sayre, 2010).

State figures show that employment remained relatively steady in Louisiana in August, September, and October, and oil and gas employment remained fairly constant (Schmidt, 2010a and 2010b; Magill, 2010). To date, the suspension has not triggered the significant economic impacts that were originally estimated (and described in the preceding paragraphs). Even though many deepwater rigs that remain in the GOM are not currently working, drilling contractors have decided, to date, to retain most of their crews in the interest of holding on to drilling expertise in the hope of restarting quickly once they are able. Similarly, rig operators and well-servicing firms have largely retained their employees (USDOC, 2010). Many employers have been keeping their workers busy doing maintenance and repair work. Although the official numbers have not changed much, the State's count of workers does not track the cuts to hours and benefits that oilfield workers claim they have been experiencing as a result of the deepwater-drilling ban. There is evidence of some increased demand for assistance in affected areas as a result of those cuts (Schmidt, 2010a). Also, in the absence of active drilling, companies have no need for certain kinds of services and equipment, and this affects the revenues (and employment levels) of many small businesses in the area (Nolan, 2010). Companies, particularly independents and small businesses, have been unable to make new, important investments, have stopped hiring workers, and have been forced to drain their reserves while they sit and wait (Broder, 2010). Smaller or nonexistent paychecks also add up to less tax revenues along the Gulf Coast.

In addition to the small businesses, another group that has been hard hit in recent months has been the shallow-water rig workers who, unlike their deepwater counterparts, are ineligible for the $100 million Rig Worker Assistance Fund established by BP and administered by the Baton Rouge Area Foundation. While there was no suspension of shallow-water drilling, it has been affected by permitting delays. According to a spokesman for the advocacy group Shallow Water Energy Security Coalition, some 500 workers were laid off across the shallow-water sector through October (December 2010). Shallow-water driller's woes are aggravated by the fact that these rigs operate on contracts with oil companies ranging from a few days to a few months. While idle deepwater rigs, which are leased out for years, keep bringing in cash for their owners, shallow-water rigs are in limbo when contracts end. According to Dr. Dismukes at Louisiana State University, 624 deepwater rig workers started the application with the Baton Rouge Area Foundation, but only 343 provided a complete package (Dismukes, official communication, 2010f).

To date, U.S. State and local governments are also faring far better than forecast, largely because of massive cleanup spending, according to Moody's Investor Service (Connor, 2010). Moody's had named 59 debt issues that might have been affected by the oil disaster, which had raised fears that populations might decline and that local property values and tax revenue would be decreased. Moody's reports that its analysts had determined that vital government revenue, such as property taxes, utility charges, and State school district funding, had broadly held up and that the fiscal pressures have been manageable and are not likely to be of a long-term nature (Connor, 2010).

Whatever the actual numbers turn out to be, much of the employment loss will be concentrated in coastal oil-service parishes in Louisiana (St. Mary, Terrebonne, Lafourche and Plaquemines Parishes) and counties/parishes where drilling-related employment is most concentrated (Harris County, Texas [Houston]; Lafayette and Iberia Parishes, Louisiana) (Nolan and Good, 2010; U.S. Dept. of Labor, Bureau of Labor, 2010b; USDOC, 2010). The BOEMRE will continue to monitor Federal, State, and public data and analyses conducted on the economic and employment impacts of the spill and provide updated information as it becomes available. As noted above, additional detailed information on employment impacts to tourism and both recreational and commercial fishing can also be found in **Chapters 4.1.1.16, 4.1.1.15, and 4.1.1.14**.

Information regarding the impacts of the DWH event on the region's economy and employment is still being developed and compiled. However, while this information may be relevant, it would not be essential to a reasoned choice among alternatives. The incremental impact of the proposed action would be small (less than 1%), even in light of how the DWH event changed the economic baseline. The expected incremental effects from the proposed action would occur 3-7 years from the lease sale and would likely occur long after the impacts to the economy from the DWH event are stabilized. In any event, the existing data indicate that the DWH event did not cause a significant change to the economic baseline, except potentially in the short term.

4.1.1.18.3.2. Impacts of Routine Events

Background/Introduction

The detailed description of possible impacts on economic factors, primarily employment, from routine activities associated with the WPA proposed action is given in Chapter 4.2.1.1.13.3 of the Multisale EIS and in Chapter 4.1.16.3.2 of the 2009-2012 Supplemental EIS. The economic analysis for the proposed WPA lease sale focuses on the potential direct, indirect, and induced impacts of the OCS oil and gas industry on the population and employment of the counties and parishes in the analysis region defined in Chapter 3.3.5.1 of the Multisale EIS.

Proposed Action Analysis

Tables 4-22 and 4-23 of the Multisale EIS provide the low- and high-case employment projections for the proposed WPA lease sale by economic impact area over the 40-year life. Because of the changes made to the exploration and development scenarios used in the analysis of proposed WPA Lease Sale 218, BOEMRE made corresponding adjustments to the employment projections. Based on these adjustments, direct employment for the entire economic impact area associated with the proposed WPA lease sale is approximately 1,185-2,350 during the peak impact year for the low- and high-case scenarios. Indirect employment is projected at about 500-950 jobs, while induced employment is calculated to be about 775-1,500. Thus, total employment in the EIA resulting from proposed WPA Lease Sale 218 is not expected to exceed 2,460-4,800 jobs in any given year over the proposed action's 40-year lifetime. Most of the employment related to proposed WPA Lease Sale 218 is expected to occur in Texas (EIA TX-3) and Louisiana (EIA's LA-2, LA-3, and LA-4). It should be emphasized, however, that a portion of these estimates do not represent "new" jobs; many of these would represent new contracts or orders at existing firms that would essentially keep the firm operating at its existing level as earlier contracts and orders are completed and filled. In other words, a portion of these 2,460-4,800 jobs would be staffed with existing company labor force and would simply maintain the status quo. Thus, these estimates may overestimate the actual magnitude of new employment effects from the proposed action. Considering Florida's current opposition to oil and gas development in offshore waters and the scarcity, if not absence, of onshore supporting service bases, BOEMRE anticipates that very few OCS-related activities would be staged from Florida.

Using the new Woods & Poole Economics, Inc. (2010) data discussed above as the baseline, BOEMRE recalculated the employment impacts on a percentage basis. The revised numbers do not differ substantially from those presented in the Multisale EIS and the 2009-2012 Supplemental EIS. Employment is not expected to exceed 1 percent of total employment in any given EIA of Texas, Louisiana, Mississippi, Alabama, or Florida. On a percentage basis, EIA LA-2 is still projected to have the greatest employment impact at 0.2 percent, followed by LA-3 and TX-3, both at 0.1 percent.

Summary and Conclusion

Should proposed WPA Lease Sale 218 occur, there would be only minor economic changes in the Texas, Louisiana, Mississippi, Alabama, and Florida EIA's. This is because the demand would be met primarily with the existing population and labor force. Proposed WPA Lease Sale 218 is expected to generate less than a 1 percent increase in employment in any of these subareas. Most of the employment related to proposed WPA Lease Sale 218 is expected to occur in Texas (EIA TX-3) and Louisiana (EIA's

LA-2, LA-3, and LA-4). The demand would be met primarily with the existing population and labor force for reasons discussed above.

4.1.1.18.3.3. Impacts of Accidental Events

Background/Introduction

A detailed description of the possible impacts from accidental events associated with the WPA proposed action on economic factors, primarily employment, is presented in Chapter 4.4.14.3 of the Multisale EIS and in Chapter 4.1.16.3.3 of the 2009-2012 Supplemental EIS. Accidental events associated with the WPA proposed action, such as oil or chemical spills, blowouts, and vessel collisions, would likely have minimal, if any, net effects on employment.

Proposed Action Analysis

Chapters 4.3.1.5, 4.3.1.6, and 4.3.4 of the Multisale EIS depict the risks and number of spills estimated to occur for the proposed action. The probabilities of an offshore spill ≥1,000 bbl occurring and contacting coastal counties and parishes was used as an indicator of the risk of a slick from such a spill reaching sensitive coastal environments. Figure 4-13 of the Multisale EIS shows the Gulf of Mexico coastal counties and parishes having a risk of >0.5 percent of being contacted within 10 days by an offshore oil spill ≥1,000 as a result of the WPA proposed action. Most counties and parishes have a <0.5 percent probability of an oil spill ≥1,000 bbl occurring and contacting (combined probability) their shorelines within 10 days; six counties in Texas and one parish in Louisiana have a 1-5 percent chance of an OCS offshore oil spill ≥1,000 bbl occurring and reaching their shoreline within 10 days as the result of the proposed action over its 40-year life. In Texas, Matagorda County has the greatest risk (3-5%) of being contacted within 10 days by an oil spill occurring offshore as a result of the WPA proposed action. The BOEMRE estimates that between 5 and 15 chemical spills associated with the OCS Program are anticipated each year, with a small percentage of these associated with the proposed action. The majority of spills are expected to be <50 bbl in size; a chemical spill of ≥1,000 bbl as a result of the proposed action or OCS Program is very unlikely.

The immediate social and economic consequences for the region in which a spill occurs are a mix that includes not only additional opportunity cost jobs and sales but also nonmarket effects such as traffic congestion, strains on public services, shortages of commodities or services, and disruptions to the normal patterns of activities or expectations. These negative short-term social and economic consequences of a spill are expected to be modest as measured by projected cleanup expenditures and the number of people employed in cleanup and remediation activities. Negative long-term economic and social impacts may be more substantial if fishing, shrimping, oystering, and/or tourism were to suffer or were to be perceived as having suffered because of the spill, or if there were substantial changes to the energy industries in the region as a result of the spill. Additional information on employment impacts to tourism and both recreational and commercial fishing from accidental events can be found in **Chapters 4.1.1.16, 4.1.1.15, and 4.1.1.14**. For a discussion of the employment impacts of catastrophic spill, see **Appendix B**.

Net employment impacts from a spill are not expected to exceed 1 percent of baseline employment for any EIA in any given year even if they are included with employment associated with routine oil and gas development activities associated with proposed WPA Lease Sale 218. The employment impacts from a vessel collision are likely to be shorter term and less than those from a spill.

Summary and Conclusion

The short-term social and economic consequences for the Gulf coastal region should a spill ≥1,000 bbl occur includes the opportunity cost of employment and expenditures that could have gone to production or consumption rather the spill cleanup efforts. Nonmarket effects such as traffic congestion, strains on public services, shortages of commodities or services, and disruptions to the normal patterns of activities or expectations are also expected to occur in the short term. These negative, short-term social and economic consequences of a spill are expected to be modest in terms of projected cleanup expenditures and the number of people employed in cleanup and remediation activities. Negative, long-term economic and social impacts may be more substantial if fishing, shrimping, oystering, and/or tourism were to suffer or were to be perceived as having suffered because of the spill or if there were substantial changes to the energy industries in the region as a result of the spill. Net employment impacts from a spill are not expected to exceed 1 percent of baseline employment for any EIA in any given year even if they are included with employment associated with routine oil and gas development activities associated with proposed WPA Lease Sale 218.

4.1.1.18.3.4. Cumulative Impacts

Background/Introduction

A detailed discussion of the cumulative impacts to economic factors, primarily employment, can be found in Chapter 4.5.15.3 of the Multisale EIS and in Chapter 4.1.16.3.4 of the 2009-2012 Supplemental EIS. The following is a summary of the information presented in these documents and incorporates new information found since their publication.

The cumulative economic analysis focuses on the potential direct, indirect, and induced employment impacts of the OCS Program's oil and gas activities in the Gulf of Mexico, together with those of other likely future projects, actions, and trends in the region. Most approaches to analyzing cumulative effects begin by assembling a list of "other likely projects and actions" that to be included with the proposed action for analysis. However, no such list of future projects and actions could be assembled that would be sufficiently current and comprehensive to support a cumulative analysis for all 132 of the coastal counties and parishes in the analysis area over a 40-year period. Instead of an arbitrary assemblage of future possible projects and actions, the analysis employs the economic and demographic projections from Woods & Poole Economics, Inc. (2010) to define the contributions of other likely projects, actions, and trends to the cumulative case. These projections are based on local, regional, and national trend data as well as likely changes to local, regional, and national economic and demographic conditions. Therefore, the projections include employment associated with the continuation of current patterns in OCS leasing activity as well as the continuation of trends in other industries important to the region. These Woods & Poole Economics, Inc. projections represent a more comprehensive and accurate appraisal of cumulative conditions than could be generated using the traditional list of possible projects and actions. The same regional economic impact assessment methodology used to estimate changes to employment from the proposed lease sale was used for the cumulative analysis. Using the new Woods & Poole Economics, Inc. (2010) data discussed above as the baseline, BOEMRE recalculated the employment impacts of the OCS Program on a percentage basis. These revised numbers do not differ significantly from those presented in the Multisale EIS.

Tables 4-45 and 4-46 of the Multisale EIS present projected employment associated with the OCS Program. These projections have not changed for this analysis, as the exploration and development scenarios associated with the OCS Program did not change. Based on the model results, direct employment in the BOEMRE-defined EIA associated with OCS Program activities is estimated to range between 126,000 and 160,000 jobs during peak activity years for the low and high resource estimate scenarios, respectively. Indirect employment is projected between 48,000 and 62,000 jobs, while induced employment is projected between 83,000 and 106,000 jobs for the same period. Therefore, total employment resulting from OCS Program activities in the BOEMRE-defined EIA is not expected to exceed 257,000-328,000 jobs in any given year over the 40-year analysis period.

In Texas, the majority of OCS-related employment is expected to occur in EIA TX-3, which also represents the largest projected employment level of any EIA. This employment is expected to never exceed a maximum of 2.2 percent of total employment in that EIA. The OCS-related employment for EIA's LA-2, LA-3, and LA-4 is also projected to be substantial. Direct employment levels in LA-2 and LA-3 are comparable, with LA-2 slightly higher. However, the impacts on a percentage basis are much higher in LA-2, reaching a maximum of nearly 20.3 percent versus about 8 percent in LA-3. However, the percentage analysis is highly dependent on the baseline employment projections, which are dependent on the size of the EIA. The EIA LA-2 has one labor market area (Lafayette) while LA-3 has two labor market areas (Baton Rouge and Houma). It follows that the baseline employment projections for LA-2 are less than (in this case, less than half) the baseline employment projections for LA-3 and that the resulting percentage impacts in LA-2 are more than twice as high. Nonetheless, over the last decade there has been a migration to Lafayette Parish (and to a lesser extent Iberia Parish) from areas throughout coastal Louisiana, particularly in the extraction and oil and gas support sectors. The next greatest impacts in percentage terms are in LA-4, LA-1, TX-3 and TX-2, respectively, with none exceeding 5 percent in any given year. The OCS-related employment for TX-1 and all of the Alabama, Mississippi, and Florida EIA's is not expected to exceed 2 percent of the total employment in any EIA.

Employment demand will continue to be met primarily with the existing population and available labor force in most EIA's. The vast majority of these cumulative employment estimates represent existing jobs from previous OCS-Program actions. The BOEMRE does expect some employment will be met through in-migration; however, this level is projected to be small and localized and, thus, BOEMRE expects the sociocultural impacts from in-migration to be minimal in most EIA's. Peak annual changes in the population, labor, and employment of all EIA's resulting from the OCS Program are minimal, except in some parts of Louisiana. As discussed in **Chapter 4.1.1.18.3.2**, proposed WPA Lease Sale 218 is expected to have an incremental contribution of <1 percent to the employment level in any of the EIA's.

Summary and Conclusion

The OCS Program would produce only minor economic changes in the Texas, Mississippi, Alabama, and Florida EIA's. The OCS Program is expected to represent <2.2 percent of employment projected in of the EIA's in these states. However, the OCS Program is projected to substantially impact LA-2 and LA-3, with OCS-related employment expected to peak at 20.3 percent and 8 percent of total employment, respectively. As discussed in **Chapter 4.1.1.18.3.2**, proposed WPA Lease Sale 218 is expected to have an incremental contribution of <1 percent to the employment level in any of the EIA's.

4.1.1.18.4. Environmental Justice

The BOEMRE has reexamined the analysis for environmental justice presented in the Multisale EIS and the 2009-2012 Supplemental EIS, based on the additional information presented below and in consideration of the DWH event. No substantial new information was found that would alter the impact conclusion for environmental justice presented in the Multisale EIS and the 2009-2012 Supplemental EIS.

On February 11, 1994, President Clinton issued Executive Order 12898, entitled *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, which directs Federal agencies to assess whether their actions have disproportionate environmental effects on people of ethnic or racial minorities or people living below the poverty line. Those environmental effects encompass human health, social, and economic consequences. The BOEMRE has examined environmental justice for the WPA proposed action and has provided opportunities for community input during the NEPA process. (See **Chapter 5** for a discussion of scoping, and community consultation and coordination.)

Environmental justice is a complex issue, and although methodologies have evolved to assess whether an environmental injustice has taken place, this type of analysis still poses challenges, particularly when considering OCS leasing decisions. First, the OCS Program in the Gulf of Mexico is large and has been ongoing for more than 50 years. During this period, substantial leasing has occurred off Texas, Louisiana, Mississippi, and Alabama. The OCS lease sales occur in Federal waters 3 mi (5 km) or more from shore; thus, the resulting exploration, development,, and production activities on leaseholds are distant from human habitation. State offshore oil and gas leases are closer to land and their petroleum-related activities in State waters are generally viewed as having greater potential for directly impacting coastal communities. Second, most OCS sale-related impacts that potentially might affect environmental justice are indirect, arising onshore as the result of industry activities in support of OCS exploration, development, extraction, and production. An extensive upstream, support infrastructure system exists to support offshore oil and gas and includes platform fabrication yards, shipyards, repair and maintenance yards, onshore service bases, heliports, marinas for crewboats and supply boats, pipeline coating companies, and waste management facilities. Downstream infrastructure moves hydrocarbon product to market and includes gas processing plants, petrochemical plants, transportation corridors, petroleum bulk storage facilities, and gas and petroleum pipelines. This infrastructure system is both widespread and concentrated. Much infrastructure is located in coastal Louisiana, less in coastal Texas, and less still in Mississippi's Jackson County and Alabama's Mobile County. While many fabrication and supply facilities are concentrated around coastal ports, downstream processing is concentrated more in industrial corridors farther inland (The Louis Berger Group, Inc., 2004).

This analysis identifies potential environmental justice impacts that might arise from these support activities, but they are only indirectly influenced by BOEMRE decisionmaking, and BOEMRE has no regulatory authority over them. Third, the resulting onshore support activities occur in the context of a very large and long-established oil industry. For the most part, activities generated by a new sale occur where there are ongoing ones, and the two are virtually indistinguishable from each other or from established land-use patterns. Each industry sector and its associated impacts are often cumulative and occur within a mix of the effects of other sectors in each geographic location. Several of BOEMRE's past and ongoing studies (e.g., Hemmerling and Colten, 2003 and in preparation) seek to understand the underlying socioeconomic and potential environmental justice implications of OCS activities.

4.1.1.18.4.1. Description of the Affected Environment

A detailed description of environmental justice from the WPA and CPA can be found in Chapters 4.2.1.1.13.4 and 4.2.2.1.15.4 of the Multisale EIS. Additional information regarding the additional 181 South Area and any new information found since the publication of the Multisale EIS is presented in Chapter 4.1.16.4.1 of the 2009-2012 Supplemental EIS. The following information is a summary of the resource description incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

The oil and gas exploration and production industry and its associated support sectors are interlinked and widely distributed along the Gulf Coast. Offshore OCS-related industry operations within the WPA may rely on onshore facilities within the WPA, the CPA, or both. As an example, Port Fourchon in Lafourche Parish, Louisiana, caters to 90 percent of all deepwater oil production in the GOM and roughly 45 percent of all shallow-water rigs in the Gulf (Loren C. Scott & Associates, 2008). While this analysis focuses on potential impacts within the WPA, the interlinked nature of the offshore industry necessitates a discussion of the CPA as well. Within the GOM economic impact areas, there are 81 counties/parishes that contain facilities, with 5 as the median number of facilities. For comparative purposes, counties/parishes with more than five are considered to contain concentrations of facilities. These 39 counties/parishes are then divided into three levels of infrastructure concentration: low (6-15 facilities); medium (16-49 facilities); and high (50 or more facilities). The WPA has four high concentration counties/parishes, and the CPA has six, five of which are located in Louisiana. Most of the counties/parishes with low and medium concentrations are located in Texas (WPA) or Louisiana (CPA).

The OCS activities (and their potential environmental consequences) are concentrated around support infrastructure such as ports, canals, heliports, repair yards, pipecoating facilities, and gas processing plants. While the coastal zone of the northern GOM is not a physically, culturally, or economically homogenous area, some communities within its boundaries warrant an environmental justice lens (Gramling, 1984). The USEPA's guidelines suggest different thresholds for determining whether a community or local population should be considered an environmental justice population. The BOEMRE focuses on counties/parishes with high or medium concentration of OCS-related infrastructure and defines minority populations as those counties/parishes with a higher percentage of their population that is minority relative to their respective State averages. Because U.S. Census data aggregated at the county/parish level are very broad, this environmental justice analysis also considers population distributions at the smaller, more detailed census tract level to assess relationships between OCS leasing effects and geographic distributions of minority populations. While this allows for a consistent metric for all Gulf States, it is important to keep in mind that Texas's minority population makes up more than half of the State at 54.67 percent. Because U.S. Census data aggregated at the county/parish level are very broad, this environmental justice analysis also considers population distributions at the smaller, more detailed Census tract level to assess relationships between OCS leasing effects and geographic distributions of minority and low-income populations,

Environmental justice maps (**Figures 4-8 and 4-9**) display the location of oil-related infrastructure and the distribution of low-income and minority residents across GOM counties and parishes based on U.S. Census data from 2010 and a BOEMRE-funded study on Gulf Coast OCS infrastructure. Ten counties/parishes are considered to have a high concentration (50 facilities or more) of oil-related infrastructure (**Table 3-40**). Of these 10 counties/parishes, 4 are located in the WPA, and of those, two (based on the 2010 Census) have higher minority percentages than the State average: there are 67 percent minority residents in Harris County and 55.4 percent minority in Jefferson County. Harris County also ranks highest in Texas in terms of concentration of OCS-related infrastructure with 10 refineries, 27 petrochemical plants, 95 terminals, and 1 port, among other infrastructure types (Kaplan et al., in preparation). A BOEMRE-funded study using the 2000 Census and a weighting scheme to identify counties with heavy concentrations of OCS infrastructure identified clusters of Harris County where 75 percent or more of the population was black. These clusters, however, ran north-south as compared with OCS-related facilities that ran east-west. The opposite can be said for Hispanic clusters. In an area of Harris County where two petrochemical plants, a refinery, and a few small OCS-related facilities appear to be clustered, 75 percent of the population is Hispanic. Jefferson County ranks third highest in terms of concentration of OCS-related infrastructure, with 4 refineries, 2 petrochemical plants, 59 terminals, and 2 ports, among other infrastructure (Kaplan et al., in preparation). According to the Eastern Research Group's study using 2000 Census data, there are several areas where 75 percent or more of the population is black, including a cluster of two refineries and two petrochemical plants. A different situation is seen with the Hispanic population where there are no large areas with more than 50 percent Hispanic population (Kaplan et al., in preparation).

Thirteen counties/parishes are considered to have a medium concentration (16-49 facilities) of oil-related infrastructure. Of these 13 counties/parishes, 2 are located in the WPA, and of those, 2 have higher minority populations than the State average (54.67%): Nueces with a 67.12 percent minority population and San Patricio with a 57.83 percent minority population. This is consistent with South Texas trends, which is 81 percent Hispanic (Texas State Government Homepage, n.d.). Both of these counties also have more people living below the poverty line than the State average. Because these two counties contain the major metropolitan statistical area of Corpus Christi, the size and complexity of the economy and labor force preclude a measurable effect.

Poverty is defined by the Office of Management and Budget's Statistical Policy Directive 14 and the U.S. Census using a set of money income thresholds that vary by family size and composition. The official poverty thresholds do not vary geographically, but they are updated for inflation using the Consumer Price Index (U.S. Census). Tract-level household income data from the 2010 Census is not yet available, and this analysis uses the 2009 Community Survey on a county/parish level basis as a placeholder. Only one county, Jefferson County, out of the four WPA high infrastructure concentration counties has a higher poverty rate than its respective State poverty rate, with 19.1 percent of the county living below the poverty line compared with the State's 17.1 percent average. One county, Nueces, out of the three WPA medium infrastructure counties, had a higher poverty rate than the Texas rate. In the aforementioned Eastern Research Group's study, which uses Census tract data, a smaller level of geographic analysis, they found no apparent visual correlation with percent of the population living below the poverty line and OCS-related facilities within Harris County (Kaplan et al., in preparation). Along the Sabine River in Jefferson County, a low-income area was located, which visually correlates with a petrochemical plant, a refinery, and several other types of OCS-related infrastructure.

Baseline Post Hurricanes and Post the *Deepwater Horizon* Event

Whether the proposed lease sale occurs within the WPA or CPA, oil and gas exploration and production activities would rely on an established network of support and processing facilities and associated labor force both within the onshore WPA and CPA. As a result, a baseline change within the CPA could potentially alter the relative risks of a lease sale in the WPA. Therefore, where appropriate, this discussion considers recent baseline changes in the CPA. The 2008 hurricane season was particularly active for southeast Texas. Hurricane Gustav made landfall mostly in Louisiana, but 71 counties including every southeastern coastal county in Texas was designated for disaster assistance following the storm (FEMA Emergency Declaration, August 2008). This included the small coastal town of Bridge City in Orange County where nearly the entire town received heavy water damage. On September 13, 2008, Hurricane Ike made landfall over Galveston, Texas, as a large Category 2 hurricane. Ike was the fourth tropical system to strike the Texas Gulf Coast within a 3-year span (U.S. Dept. of Homeland Security, FEMA, 2008). Harris, Galveston, Chambers, Orange, and Jefferson Counties sustained the most damage from Hurricane Ike. Both Jefferson and Harris Counties are high OCS infrastructure concentration communities, and both counties have higher or equal minority percentages Texas' mean. Only Jefferson County has a higher poverty rate than the State of Texas. While Galveston is a county of high OCS infrastructure concentration, both its minority percentage and poverty rate fall below the State means. Sixty percent of the children in the area, however, receive free or reduced-price lunches in school, which is a marker of poverty (U.S. Dept. of Homeland Security, FEMA, 2008). One study found that neighborhoods with higher proportions of renters, households in poverty, and minorities were more likely to have waited to evacuate the urbanized barrier island in advance of Hurricane Ike (Van Zandt et al., 2010). This same study found that neighborhoods with higher proportions of minorities also had lower percentages of flood insurance, suggesting that areas like these will generally be slower to recover because of less private recovery resources.

The DWH event on Mississippi Canyon Block 252 has raised several concerns regarding OCS activities and environmental justice. While only few small tarballs (about 35 gallons) were found in Texas on the Crystal Beach of the Bolivar Peninsula, Texas' Gulf Coast communities, it is still unclear whether and how the DWH event might have impacted minority and low-income groups in the WPA (RestoreTheGulf.gov, 2010a). Anecdotal evidence suggests that a loss for Florida, Alabama, Mississippi, and Louisiana's economies may have been a gain for Texas. See **Chapter 4.1.1.16** for a discussion of the tourism and recreation impacts in the WPA.

The Gulf Coast hosts several distinct ethnic, cultural, and low-income groups that rely on the natural resources of the marshes, barrier islands, and coastal beaches and wetlands of the Gulf Coast. This reliance can make these groups particularly vulnerable to the direct and indirect effects of environmental impacts to the area. Besides an economic dependence on commercial fishing and oystering, low-income and minority groups along the coast rely heavily on these fisheries and on other traditional subsistence fishing, hunting, trapping, and gathering activities to augment their diets and household incomes (e.g., see Hemmerling and Colten, 2003, for an evaluation of environmental justice considerations for south Lafourche Parish). Even when landloss and destruction caused by recent hurricanes have forced families to relocate, regular commuting has sustained this reliance on the natural resources of the coastal environments.

Disruptions to the oil and gas industry due to the DWH event and the subsequent deepwater suspensions have also raised environmental justice equity concerns. The Multisale EIS states the following: "Evidence also suggests that a healthy offshore petroleum industry also indirectly benefits low-income and minority populations." Sectors such as the fabrication industry and support industries (e.g., trucking), employ minority workers and provide jobs across a wide range of pay levels and educational/skill requirements (Austin et al., 2002a and 2002b; Donato et al., 1998). Also, evidence suggests that a healthy offshore petroleum industry does indirectly benefit low-income and minority populations. For example, one Agency study in Louisiana found income inequality decreased during the 1970's oil boom and increased with the mid-1980's decline (Tolbert, 1995).

Waste Management Related to the *Deepwater Horizon* Event Waste

The USEPA's standards exempt oil and gas exploration and production wastes from Federal hazardous waste regulations. This exemption does not preclude more stringent State and local regulation, and USEPA recognizes that exploration and production wastes could present a human health hazard if not properly managed (USEPA, 2002). However, wastes from oil spills is not exempt, and the DWH event has raised the additional environmental justice concern as to whether or not low-income and minority groups have been disproportionately impacted by the disposal of wastes associated with the DWH event's containment and cleanup. Disposal procedures involved sorting waste materials into standard "waste stream types" at small, temporary stations and, then, sending each type to existing facilities that were licensed to dispose of them. The location of temporary sorting stations was determined largely by the location of containment and cleanup operations. Hence, future locations of any sorting stations would be determined by the needs of cleanup operations. However, waste disposal locations were determined by the specializations of existing facilities and by contractual relationships between them and the cleanup and containment firms. Although, in the case of the DWH event, most cleanup occurred in the CPA, disposal occurred in both the CPA and WPA. The requirements of the cleanup operations would likely determine the use of facilities both in the CPA and WPA should a future event occur. **Tables 4-41 and 4-42** identify the DWH waste disposal sites that received the greatest percentages of waste and the waste types received. **Table 4-43** also shows minority and low-income percentages, as well as the density of populations living within 1 mi (1.6 km) of each site. **Figure 4-10** is a map that shows the location of all sites that received DWH waste. Argonne National Laboratory reported that there are 46 waste management facilities that service the oil and gas industry along the GOM, with 18 in Louisiana, 18 in Texas, 5 in Mississippi, 4 in Alabama, and 1 in Florida (Puder and Veil, 2006). Louisiana received about 82 percent of the DWH event's liquid waste recovered; of this, 56 percent was manifested to mud facilities located in Venice, Plaquemines Parish, Louisiana, and Port Fourchon, Lafourche Parish, Louisiana, and then transferred to a processing facility in Port Arthur, Texas. The waste remaining after processing was sent to deep well injection landfills located in Fannett and Big Hill, Texas. The sites located in Venice and Port Fourchon, Louisiana, and Port Arthur, Fannett, and Big Hill, Texas, have low minority populations, but a few of these areas have substantial poverty rates relative to State and county means.

Several ongoing studies also seek to understand the short- and long-term impacts of the recent DWH event (e.g., the study "Ethnic Groups and Enclaves Affected by OCS," which was launched on August 1, 2010). Information regarding the impacts of the DWH event remains incomplete at this time. Studies regarding environmental justice concerns in light of the DWH event are only in their infancy, and it may be years before data are available and certainly not within the timeframe of this NEPA analysis. The NRDA process, which is ongoing, may help to inform issues relating to subsistence and other indigenous reliance on natural resources. This information is unavailable and unobtainable at this time, regardless of costs. In its places, the subject-matter experts have used credible information that is available and applied using accepted socioeconomic methodologies. Although most criteria related to environmental justice may not be essential to a reasoned choice among the alternatives, health impacts would generally be essential. Nevertheless, long-term health studies are pending and may not be available for use for several years or longer. What credible information is available was applied using accepted methodologies in the health analysis below. The BOEMRE will continue to seek additional information as it becomes available.

4.1.1.18.4.2. Impacts of Routine Events

Background/Introduction

A detailed analysis of the routine impacts on low income and minority communities and environmental justice as a whole for proposed WPA Lease Sale 218 can be found in Chapter 4.2.1.1.13.4 of the Multisale EIS and in Chapter 4.1.16.4.2 of the 2009-2012 Supplemental EIS. Impact analyses for the 181 South Area that included new information since publication of the Multisale EIS is presented in Chapter 4.1.16.4.1 of the 2009-2012 Supplemental EIS. **Chapter 4.1.1.18.4.1** describes the widespread presence of an extensive OCS support system and associated labor force, as well as economic factors related to OCS activities. The following information is a summary of the impact analysis incorporated from the Multisale EIS and the 2009-2012 Supplemental EIS, and new information that has become available since both documents were prepared.

Impact-producing factors associated with proposed WPA Lease Sale 218 that could affect environmental justice include the following: (1) potential infrastructure changes/expansions including (a) fabrication yards, (b) support bases, and (c) onshore disposal sites for offshore waste; (2) increased commuter and truck traffic; and (3) employment changes and immigration. Possible changes/expansions/increases to any of these routine impact-producing factors of OCS activities occur in the context of long-lived State and Federal oil and gas leasing programs and as incremental additions to a robust offshore oil and gas industry. As a result, the impacts from routine events produced by proposed WPA Lease Sale 218 due to these factors are also incremental. Particularly in the case of potential social impacts, it is often not possible to separate out each additional new OCS program effect from ongoing impacts because dynamic economic and political factors can influence investment decisions that, one way or another, reverberate through many of the OCS economic impact areas. While individual sales have little influence on the factors causing impacts from routine events, the overall OCS leasing may have more. For this reason, the factors considered in this chapter are explored in more detail in the cumulative analysis **Chapter 4.1.1.18.4.4**. Offshore operations within the WPA may be supported by onshore facilities within the CPA. For example, Port Fourchon in Lafourche Parish, Louisiana, caters to 90 percent of all deepwater oil production in the Gulf of Mexico and roughly 45 percent of all shallow-water rigs in the Gulf (Loren C. Scott & Associates, 2008). Therefore, this analysis of possible impacts due to the WPA proposed lease sale addresses potential impacts due to the CPA as well. The BOEMRE estimates that production from the WPA proposed action would be 0.222-0.423 BBO and 1.495-2.647 Tcf of gas, which is a marginal decrease in production from the last lease sale.

Proposed Action Analysis

The Executive Order mandating an environmental justice analysis arose out of cases where minority and/or low-income communities disproportionately bore the environmental risk or direct burdens of industrial development or Federal actions. As discussed in **Chapter 4.1.1.18.4.1**, the OCS Program in the GOM is large and has been ongoing for more than 50 years. While the program is offshore, onshore activities related to it occur within a mix of communities whose economies are linked in various ways and at differing levels to its many industrial sectors.

Fabrication/shipbuilding yards and port facilities are major infrastructure types that demonstrate the interlinked nature of OCS activity within the GOM and pose potential environmental justice risks. As mentioned earlier, WPA oil and gas exploration and production help to maintain ancillary industries within the WPA and CPA, including shipbuilding and port facilities. Over one-third (28 facilities) of the U.S. major shipbuilding yards are located on the GOM. Of these, most are concentrated in a 200-mi (322-km) area between New Orleans, Louisiana, and Mobile, Alabama. The offshore oil industry relies heavily on specialized port infrastructure that specifically serves the need of the industry. Such activities as repair and maintenance of supply vessels, fabrication yards, and supply bases tend to be located in ports nearest to offshore drilling operations, including 16 OCS-related service bases scattered on the Eastern coast of Texas (The Louis Berger Group, Inc., 2004). The ports of Houston, Corpus Christi, Texas City, Beaumont, and Port Arthur, Texas, are among the busiest in the Nation (Kelley, 2002). Only Harris County (which includes the city of Houston) is home to more minority residents than the State's average. Only one county, Jefferson County (which includes the city of Beaumont), out of the four WPA high infrastructure concentration counties has a higher poverty rate than its respective State poverty rate. Since proposed WPA Lease Sale 218 would help to maintain ongoing levels of activity rather than expand them, the proposed lease sale is not expected to generate new infrastructure demand sufficient to raise siting issues. Also, prior to construction, any new OCS-related onshore facility would first be required to receive approval by relevant Federal, State, county and/or parish, and community governments with jurisdiction. The BOEMRE assumes that any new construction would be approved only if it were consistent with appropriate land-use plans, zoning regulation, and other State/regional/local regulatory mechanisms. For these reasons, this Supplemental EIS considers infrastructure projections only for the cumulative analysis (**Chapter 4.1.1.18.4.4**).

All material that moves to and from an offshore platform goes through an onshore service base. Although support and transport operations are spread throughout the Gulf Coast, most producing deepwater fields have service bases in southeast Louisiana, and most of this goes through Port Fourchon in Lafourche Parish. From 1995 to 1998, both the port's acreage and waterfront footage nearly doubled, from 211 to 417 ac (85 to169 ha) and from 19,162 to 33,505 ft (5,841 to 10,212 m) of waterfront (Guo et al., 1998, p. 21). Port Fourchon has grown in recent decades, in large measure due to its role in servicing the deepwater OCS, and it is currently undergoing a 400-ac (16-ha) expansion.

LA Hwy 1 is the primary north-south corridor through Lafourche Parish and is the principal transportation route for trucks entering and exiting Port Fourchon. According to the LA 1 Coalition, a nonprofit corporation working to improve LA Hwy 1, between 1991 and 1996, there were over 5,000 accidents along this largely rural two-lane highway. According to some studies, LA Hwy 1's fatality rate is double that of similar highways (LA 1 Coalition, 2010a). Additionally, LA Hwy 1 is the only means of hurricane evacuation for thousands of people. Approximately 35,000 people, including 6,000 offshore workers, use LA Hwy 1 for evacuation (LA 1 Coalition, 2010a). According to one study, the average daily traffic along LA Hwy 1 appears to be heavily influenced by the overall level of oil and gas activities and due to increased demand, particularly for deepwater services, could grow by as much as 6 percent during the next 10 years (Guo et al., 1998). Residents along the highway have expressed concern over LA Hwy 1's adequacy for traffic congestion, desiring improved hurricane evacuation and emergency medical transportation routes (USDOT, Federal Highway Administration, 2004).

While local governments near the service bases have gained revenue from the increased activity within their jurisdictions, the demands for additional services and facilities resulting from oil and gas operations have sometimes exceeded growth in the revenue stream. A Federal cost share helped support the construction of the Leeville Bridge in 2009, considered the weakest link of the LA Hwy 1 system; the two-lane Leeville overpass is expected to open to traffic in November 2011 (LA 1 Coalition, 2010b). A proposed 27.5 mi (44.3 km) of improvements to the Port Fourchon highway system have yet to be funded, and continued growth of Port Fourchon and associated road traffic will add to an increased risk for users of and residents along the highway. As described in **Chapter 4.1.1.18.4.2,** community string settlement patterns (in this case, on high ground along LA Hwy 1 and Bayou Lafourche) mean that luxury fishing camps and low-income groups would be affected alike by any increased traffic. An Agency-funded study compared the percentage of different minority populations within an affected area with the percentage of that population for the state (Hemmerling and Colten, 2003). Using this method, two minority populations are at greater risk. Hispanics are 1.36 times more likely to live along the transportation corridor and Native Americans are twice as likely to live along the corridor as anywhere else in the parish (Hemmerling and Colten, 2003). While the majority of OCS-related infrastructure in south Lafourche Parish is near where the Houma Indian population resides, the proposed WPA lease sale would not significantly alter this preexisting situation. Over the last two decades, the area has experienced increased truck traffic and its associated effects due to increasing offshore-related activities at Port Fourchon. Since proposed WPA Lease Sale 218 would not significantly alter this preexisting situation, minority and low-income populations would not sustain disproportionate adverse effects from the proposed action.

The development of any new oilfield would result in an increase in hazardous materials transported onshore. An estimated 0.2-2.0 bbl of total drilling waste are produced for each vertical foot drilled, although not all oilfield waste is considered hazardous material (USEPA, 2000, p. 37). An entire lease sale usually represents less than 1 percent of the total current permitted landfill capacity in the GOM economic impact area. The BOEMRE rules require that all waste considered hazardous be transported onshore for disposal, which lowers the risks to the environment but increases the risk to those people currently living along the hazardous transportation routes (NTL 2009-G35, USDOI, MMS, 2009e). The USDOT currently recommends a default isolation distance of one-half mile around any roadway involved in a hazardous chemical fire. Argonne National Laboratory reported that there are 46 waste management facilities that service the oil and gas industry along the GOM, with 18 in Louisiana, 18 in Texas, 5 in Mississippi, 4 in Alabama, and 1 in Florida (Puder and Veil, 2006). Because a relatively small amount of waste results from a single lease sale and because of the difficulty of separating the relative contribution of all OCS waste from municipal waste in general or distinguishing the effects on nearby communities of OCS waste disposal from the disposal of other waste, this Supplemental EIS addresses the marginal contribution of proposed WPA Lease Sale 218 waste issues as part of the cumulative analysis (**Chapter 4.1.1.18.4.4**). While most waste disposal facilities along the GOM suffered little reported damage during recent hurricane seasons, a discussion of potential impacts to these sites as a result of storms is addressed in the cumulative analysis as well.

The WPA proposed action is expected to marginally increase employment opportunities in a wide range of businesses along the Gulf Coast. See **Chapter 4.1.1.18.3** for a discussion of employment projections as a result of the projected lease sale. The BOEMRE employment projections can neither estimate the socioeconomic or ethnic composition of new employment nor identify the communities in which that employment would likely occur. Sectors such as the fabrication industry and support industries (e.g., trucking) employ minority workers and provide jobs across a wide range of pay levels and educational/skill requirements (Austin et al., 2002a and 2002b; Donato et al., 1998). Also, evidence suggests that a healthy offshore petroleum industry does indirectly benefit low-income and minority populations. For example, one Agency study in Louisiana found income inequality decreased during the 1970's oil boom and increased with the mid-1980's decline (Tolbert, 1995). Because of the expected concentration of employment effects in Lafourche Parish, it is also the only parish where the additional OCS-related activities and employment may be sufficient to increase stress to its infrastructure. One study found that, because of local labor shortages, employers actively recruited foreign employees including Laotian refugees and Mexican migrant workers. This trend has, in turn, applied pressure on available housing stocks within some GOM coastal communities that exhibited varying degrees of results in incorporating new residents into local communities (Donato, 2004). However, these effects arose during a time of a booming economy and high employment in general. Because of more recent declines in employment in the oil and gas industry, many communities in southeast Texas have focused on diversification as a strategy to reduce dependency on the industry (Kelley, 2002). Based on BOEMRE estimates, the WPA proposed action would provide little additional employment growth. Instead, it would have the effect of maintaining current activity and employment levels, which is expected to have beneficial, although limited, direct and indirect employment effects to low-income and minority populations.

Summary and Conclusion

Because of the existing extensive and widespread support system for OCS-related industry and associated labor force, the effects of proposed WPA Lease Sale 218 are expected to be widely distributed and to have little impact. This is because the proposed action is not expected to significantly change most of the existing conditions, such as traffic or the amount of infrastructure. In general, who would be hired and where new infrastructure might be located is impossible to predict, but, in any case, it would be very limited. Impacts related to the WPA proposed action are expected to be economic and to have a limited but positive effect on low-income and minority populations. Given the existing distribution of the industry and the limited concentrations of minority and low-income peoples, the WPA proposed action is not expected to have a disproportionate effect on these populations within the WPA.

Future changes in activity levels would most likely be caused by fluctuations in oil prices and imports, and not by activities related to the proposed action. The WPA proposed action is not expected to have disproportionate high/adverse environmental or health effects on minority or low-income people.

4.1.1.18.4.3. Impacts of Accidental Events

Background/Introduction

Impacts of accidental events on environmental justice for proposed WPA Lease Sale 218 can be found in Chapter 4.4.14.4 of the Multisale EIS. Impact analyses for the 181 South Area that includes any new information since publication of the Multisale EIS is presented in Chapter 4.1.16.4.3 of the 2009-2012 Supplemental EIS. The following information is a summary of the impact analyses incorporated from the Multisale EIS and the Supplemental EIS, and new information available since both documents were prepared.

Proposed Action Analysis

Impact-producing factors associated with the WPA proposed action that could affect environmental justice include (1) oil spills, (2) vessel collisions, and (3) chemical/drilling-fluid spills. These factors could affect environmental justice through (1) direct exposure to oil, dispersants, degreasers, and other chemicals that can affect human health; (2) decreased access to natural resources due to environmental damages, fisheries closures, or wildlife contamination; and (3) proximity to onshore disposal sites used in support of oil and chemical spill cleanup efforts. The DWH event was an accidental event of catastrophic proportion and should be distinguished from accidental events that are smaller in scale and occur more frequently. Detailed analysis of a high-impact, low-probability catastrophic event such as the DWH event may be found in **Appendix B**. Actions occurring within the WPA may impact environmental justice within the CPA, and vice versa. Facilities located on the coasts of the CPA may provide support for offshore activities on the WPA, and vice versa. Oil and chemical spills on the WPA may be carried by winds and currents to the coasts of the CPA, and vice versa. As a result, a discussion of a potential accidental event within the proposed WPA Lease Sale 218 area addresses potential impacts of accidental events to environmental justice both in the CPA and the WPA.

Potential oil spills, including surface spills and underwater well blowouts, may be associated with exploration, production, or transportation phases of the WPA proposed action. Detailed risk analysis of offshore oil spills ≤1,000 bbl and coastal spills associated with the WPA proposed action is provided in Chapters 4.3.1.4, 4.3.1.6, and 4.3.1.7 of the Multisale EIS, respectively. When oil is spilled in offshore areas, much of the oil volatilizes or is dispersed by currents, so it has a low probability of contacting coastal areas. Low-income and minority populations might be more sensitive to oil spills in coastal waters than the general population because of their dietary reliance on wild coastal resources, their reliance on these resources for other subsistence purposes such as sharing and bartering, their limited flexibility in substituting wild resources with purchased ones, and their likelihood of participating in cleanup efforts and other mitigating activities. **Table 3-7** contains the estimated number of oil spills that could happen in Gulf coastal waters as a result of an accidental event associated with the WPA proposed action.

Vessel collisions may be associated with exploration, production, or transportation activities that result from the WPA proposed action and are the most common source of OCS-related spills. Chapter 4.3.3 of the Multisale EIS provides a detailed discussion of vessel collisions. The BOEMRE data show that, from 1996 through 2005, there were 129 OCS-related collisions. The majority of vessel collisions involve service vessels colliding with platforms or pipeline risers, although sometimes vessels collide with each other. These collisions often result in spills of various substances, and while most occur on the OCS far from shore, collisions in coastal waters can have consequence to low-income and minority communities. For example, on July 23, 2008, a barge carrying heavy fuel collided with a tanker in the Mississippi River at New Orleans, Louisiana. Over several days the barge leaked an estimated 419,000 gallons of fuel. From New Orleans to the south, 85 mi (137 km) of the river were closed to all traffic while cleanup efforts were undertaken, causing a substantial backup of river traffic (USDOC, NOAA, 2008c). Downriver from the collision, cities and parishes that pull drinking water from the river (i.e., Gretna, Algiers, St. Bernard and Plaquemines Parish) shut their water intakes out of fear of possible treatment system contamination (Tuler et al., 2010). Not only can these types of events erode public confidence in governmental and corporate institutions, they may compromise municipal services for which low-income communities may be financially unable to find private market substitutions, interfere with people's ability to use natural resources, or even interfere with people's ability to travel to work, as in the case of this spill, which temporarily shutdown ferry service between Algiers and downtown New Orleans.

These types of events may impact an entire region, but low-income and/or minority groups lacking financial or social resources may be more sensitive and less equipped to cope with the disruption these events pose. Harris County, for example, has clusters of low-income, minority community along the Houston Ship Channel, which is a major conduit for OCS product and would likely receive any captured oil from an accidental event. Additionally, the 2001 Census found that 13.9 percent of Texans spoke English less than "very well" (USDOC, Census Bureau, 2003). In 2005, Texas joined Hawaii, New Mexico, and California as majority-minority states. The fastest growing key segment of the population is Hispanics (USDOC, Census Bureau, 2005, in Green, 2008). While low-income and minority populations already run the danger of being disenfranchised from a response effort and any resulting compensation for losses sustained because of an accidental event, limited English proficiency will likely create greater obstacles. The *Deepwater Horizon* Incident Command Center, which collected and distributed news and information from all Federal, State, local, and private responders (RestoreTheGulf.gov, 2011), has translations in the following languages: Cambodian, Croatian, Spanish, French, Korean, Greek, Laotian, Russian, Thai, and Vietnamese. The Gulf Coast Claims Facility website and other Gulf Coast Claims Facility's resources can be translated into Spanish, Laotian, and Vietnamese, and it also has utilizes translators to assist limited English proficiency claimants.

Chemical and drilling-fluid spills may be associated with exploration, production, or transportation activities that result from the WPA proposed action. Chapter 4.3.4 of the Multisale EIS provides a detailed discussion of chemical and drilling-fluid spills. Each year, between 5 and 15 chemical spills are expected to occur; most of these are ≤50 bbl in size. Large spills are much less frequent. For example, from 1964 to 2005, only two chemical spills of ≥1,000 bbl occurred. Dispersants are of particular concern for human health because, while dispersants are a relatively common product used to clean and control oil spills, they can evaporate from fresh crude and weathered oil and can come ashore as a result of burning oil out at sea. While additional production chemicals are needed in deepwater operations where hydrate formation is a possibility, overall spill volumes are expected to remain stable because of advances in subsea processing.

With the exception of a catastrophic accidental event, such as the DWH event, the impacts of oil spills, vessel collisions, and chemical/drilling fluid spills are not likely to be of sufficient duration to have adverse and disproportionate long-term effects for low-income and minority communities in the analysis area. As described earlier, low-income and/or minority groups lacking financial or social resources may be more sensitive and less equipped to cope with the disruption these events pose over the short term, but again, these smaller events should not have disproportionate long-term affects on low-income and minority communities.

Deepwater Horizon *Event*

While it is still too early to determine the long-term social impacts that may result from the DWH event, anecdotal evidence from media coverage and phone survey studies suggest possible trends that may represent disproportionate effects to low-income and minority communities. While these impacts were concentrated in Louisiana and Alabama with regard to the DWH event, they may be indicative of expected impacts should another catastrophic spill occur in the future. The National Center for Disaster Preparedness at the Mailman School of Public Health at Columbia University, in partnership with the Children's Health Fund, conducted a phone study (through the Marist Poll) between July 19 and July 25, 2010, of 1,203 adult residents of Louisiana and Mississippi living within a 30-minute drive from the Gulf of Mexico (Abramson et al., 2010). Survey respondents earning less than $25,000 reported having lost income as a result of the DWH event, and they were more likely than were higher earners to report physical (defined as respiratory symptoms or skin irritations) and mental health effects among themselves and their children. Black respondents were also more likely to report physical health problems both for their children and themselves as a result of the DWH event (Abramson et al., 2010). In a study of communities near the *Exxon Valdez* spill, Palinkas et al. (1992) suggest that cultural differences played an important role in the perception of the psychological damage produced by the disaster, which was related to "the cleaning work in which the people were involved and also the damage to fishing grounds, the main sustenance of these communities" (Palinkas et al., 1992). This work underscores the importance of the varying capacities of affected groups to cope with these types of events.

The Gulf Coast Claims Facility (GCCF) Program, administered by the Federal Government's Claims Administrator Kenneth R. Feinberg, has provided data on DWH spill claimants divided by claim type, payout amount, and county/parish in which the claimant worked or originated from. The fund is the official way for individuals and businesses to file claims for costs and damages incurred as a result of the oil discharges due to the DWH event. While not organized by minority or income group, these data allow us to identify where claims are being made and to compare this with environmental justice communities of note. In **Table 4-44**, total GCCF Program claimants as of November 25, 2010, are divided by state and at what stage the claimant is within the claims process. A total of 450,711 claimants, including individuals and businesses (claimants may have one or more claim type) have filed for some kind of emergency or final payment. These claims include claims for removal and cleanup costs, real or personal property, lost earnings or profits, loss of subsistence use of natural resources, and physical injury/death directly or indirectly because of the DWH event (see **Table 4-44** for a state-by-state break down). Many of these coastal counties and parishes contain large metropolitan centers as well as beach communities with economies based at least partially on tourism and recreation. Claimants can range from charter boat operators working out of Florida to bartenders working in downtown New Orleans. Either the direct effects of the DWH event or the indirect effects caused by altered perception were grounds for claims, if loss could be demonstrated. These figures include claimants living within the county or parish where the claim was made, claimants claiming losses while working in the county or parish where the claim was made, or both. Impacted industries may employ low-income and/or minority workers, and as a result, this analysis will consider both businesses and individuals within a parish or county.

There is no observable relationship between low-income or high-minority communities and the number of claims. Generally, parishes and counties directly along the coast had a higher number of individuals and businesses claiming losses because of the DWH event. As discussed in several chapters, the Texas Coast was not physically impacted by the DWH event. The Macondo well was located more than 300 mi (483 km) east of the WPA boundary, and NOAA determined that the westernmost sheen of oil related to the DWH event remained east of the WPA boundary. Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). The primary impacts revolved around consumer perception, which impacted tourism and recreation, and is discussed in greater detail in **Chapter 4.1.1.18**. The Gulf Coast Claim Facility Program's list the average amount paid to each claimant by county/parish. Texas had the lowest number of submitted claims, with approximately11,000 awarded claims totaling close to $175 million in payments. The average payout to a Texan claimant within the Gulf of Mexico OCS Economic Impact Areas is a little over $15,000 per claimant. Individual claimants could claim damages based on removal and cleanup costs, real or personal property, lost earnings or profits, loss of subsistence use of natural resources, physical injury or death, or other claims. A little over 4,000 claimants claimed to have lost income within Texas because of the DWH event, and claimants were awarded close to $153 million. Several high- or medium-OCS infrastructure counties/parishes of environmental justice concern had high numbers of residents, workers, or both claiming losses. Two high OCS-infrastructure counties discussed in **Chapter 4.1.1.18.4.1** had smaller numbers of claimants. In Harris County, 1,163 claimants in were awarded close to $83 million. In Jefferson County, 662 claimants were awarded $14 million. These numbers include both individual claimants and businesses.

Chapter 4.1.1.21.4.1 discusses the DWH event's waste disposal system. While there are concerns about whether locations would worsen existing environmental injustices, waste disposal locations were determined by the specializations of existing facilities and by contractual relationships between them and cleanup and containment firms.

Subsistence

While users of coastal waters may trend towards the relatively affluent, because of the limited ability of low-income and minority subsistence users to acquire comparable substitutes for Gulf of Mexico natural resources, they may be particularly sensitive to an oil spill and related fishery closures. Several ethnic minority and low-income groups rely substantially on subsistence-based activities for food, shelter, clothing, medicine, or other minimum necessities of life (e.g., see Hemmerling and Colten, 2003, for an evaluation of environmental justice considerations for south Lafourche Parish). The DWH event and the resulting NOAA fishing closures interrupted access to these resources for weeks or months depending on the area. A representative sample of affidavits submitted to the Gulf Coast Claims Facility (responsible for administrating DWH event claims) indicates that Louisiana commercial fishermen customarily take home approximately 5-15 percent of their total catch for subsistence use (United Louisiana Vietnamese American Fisherfolks, 2010).

As of November 27, 2010, over 29,722 DWH emergency advance payments claims had been filed claiming loss of subsistence use of natural resources. Texas had a total of 301 subsistence claims. To qualify for emergency funds, claimants were asked to identify the specific natural resource that had been injured, destroyed, or lost as a result of the DWH event; to describe the actual subsistence use for the natural resource; and to describe to what extent the subsistence use was affected by the damaged or destroyed natural resource using documentation such as store and barter receipts showing the replacement costs claimed (Gulf Coast Claims Facility, 2010b). The GCCF Program told the New Orleans newspaper, *The Times-Picayune*, that a claimant needs to "show documentation on their heritage, their history, and their having lived off the land" (Alexander-Bloch, 2010). Following negotiations with nonprofit lawyers and community advocates, the Gulf Coast Claims Facility developed a new method for calculating subsistence claims beginning on March 28, 2011 (Hammer, 2011). The GCCF said it would use scholarly studies (such as the United Louisiana Vietnamese American Fisherfolks white paper) to determine consumption amounts of different groups of commercial fishers and so-called "true subsistence fishermen," namely affected Indian tribes like the United Houma Nation. As of April 27, 2011, a total of 40 claimants had been awarded close to $384,000. Most claimants received between $0.01 and $5,000. The BOEMRE is currently funding a subsistence study of the Gulf Coast to better document subsistence distribution networks.

Health

Prior research on the health effects of oil spills have focused primarily on the acute physical symptoms of cleanup workers and wildlife caretakers. Of the 38 accidents involving supertankers and resulting in large oil spills throughout the world, only seven studies on the repercussions of the exposure of spilled oils on human health have been completed. Aguilera et al. (2010) compiled and reviewed these studies for patterns of health effects and found evidence of the relationship between exposure and "acute physical, psychological, genotoxic, and endocrine effects in the exposed individuals." Acute symptoms from exposure to oil, dispersants, and degreasers include headaches, nausea, vomiting, diarrhea, sore eyes, runny nose, sore throat, cough, nosebleeds, rash, blisters, shortness of breath, and dizziness (Sathiakumar, 2010). Sathiakumar also compiled and reviewed most of the available post-oil spill health studies and found that hydrocarbons were below occupational safety levels and that the level of benzene did not exceed threshold limit values. There has been concern regarding the use of the dispersants such as Corexit 9500, which works the same way dishwashing liquid works on grease, but it is also toxic at

2.61 ppm (Trapido, 2010). The USEPA monitoring data have so far shown that the mix of Louisiana light crude oil and Corexit 9500 was no more or less toxic than the other available alternatives, displaying no biologically significant endocrine disrupting activity, and it did not result in a presence of chemicals that surpassed human health benchmarks (Trapido, 2010; USEPA, 2010i). Studies of possible long-term health effects from exposure to either the DWH event's oil or dispersants, such as the possible bioaccumulation of toxins in tissues and organs, are lacking and the potential for the long-term human health effects are largely unknown (although the National Institutes of Health has proposed such a study). Sathiakumar also suggests long-term studies to clarify potential genotoxic and endocrine changes.

As of November 27, 2010, the GCCF Program has received 8,638 claims for emergency advance payment for physical injury/death. Of those, 18 have been paid at a total of $14,336.50. As of April 27, 2011, 85 claimants had been paid a total of $412,494. As of the end of September 2010, U.S. poison control centers had taken 1,172 exposure calls involving physical exposure to an oil-spill-related toxin (e.g., oil, dispersant, food contamination, or other associated toxin) and 681 information calls from persons with questions about the medical impact of the DWH event. Most calls originated from the Gulf States, and most exposures had come via inhalation, although some were through dermal exposure. The most common symptoms included headaches, nausea, vomiting, diarrhea, throat irritation, eye pain, coughing/choking, and dizziness (Trapido, 2010). Tulane University's Disaster Resilience Leadership Academy, along with the nonprofit health advocacy organization, the Louisiana Bucket Brigade, conducted a door-to-door health and economic impact survey in coastal Louisiana (Jefferson, Terrebonne, St. Bernard, and Plaquemines Parishes) during the summer of 2010 (LA Bucket Brigade, 2010). While no medical tests were administered and this type of survey likely suffers from self-selection bias, it does provide us a snapshot of what residents reported and their perceptions of exposure. Surveyors asked a total of 954 people a series of questions regarding their exposure to the spill event, abnormal health symptoms, and medications sought to treat ailments. Of those surveyed, 46 percent reported believing that they were exposed to oil or dispersant and, of those, 72 percent reported experiencing one symptom. Sudden onset symptoms included nausea, dizziness, and skin irritation. The Centers for Disease Control and Prevention state that an "occasional brief contact with a small amount of oil will do no harm. However, some people are especially sensitive to chemicals, including the hydrocarbons found in crude oil and petroleum products. They may have an allergic reaction, or develop dermatitis or a skin rash, even from brief contact with oil" (Centers for Disease Control and Prevention, 2010).

Sathiakumar's review (2010) also found that, in prior post-spill cleanup efforts, the duration of cleaning work was a risk factor for acute toxic symptoms and that seamen had the highest occurrence of toxic symptoms compared with volunteers or paid workers. Therefore, participants in the DWH event's Vessels of Opportunity Program, which recruited local boat owners (including Cajun, Houma Indian, and Vietnamese fishermen) to assist in cleanup efforts, would likely be one of the most exposed groups. African Americans are thought to have made up a high percentage of the cleanup workforce. The OSHA released two matrices of gear requirements for onshore and offshore Gulf operations that are organized by task (OSHA). Of past oil-spill workers, uninformed and poorly informed workers were at more risk of exposure and symptoms, demonstrating the importance of education and proper training of workers (Sathiakumar, 2010). One of the most serious health hazards reported was heat; about 740 heat-related events (i.e., illnesses) were reported for workers involved in cleanup (U.S. Dept. of Labor, OSHA, 2010).

The National Oceanic and Atmospheric Administration, the Food and Drug Administration, and State regulators have coordinated efforts to help prevent oil-tainted seafood from reaching the market. An assumption of the Food and Drug Administration's guidelines, however, is that people eat two meals of fish and one meal of shrimp per week, with no more than 3 ounces of shrimp per meal (approximately 4 jumbo shrimp). A Natural Resources Defense Council online survey of 547 Gulf Coast residents in Louisiana, Mississippi, Alabama, and Florida was conducted from August through October 2010 to assess seafood consumption rates in the Gulf coastal zone. Online survey tools generally suffer from an unknown level of selection bias; however, these numbers still provide at least a snapshot of local seafood consumption patterns, particularly for minority subsistence-reliant groups. The Asian/Pacific Islander ethnic group surveyed had an average fish consumption frequency of 5 times per week and median fish consumption frequency of 2 times per week, with some individuals reporting to eat fish 5-8 times per week (Natural Resources Defense Council, 2010). Native Americans and Asian/Pacific Islanders consumed oysters more frequently as well. The Asian ethnic group surveyed also had an average and median crab consumption frequency of 1 time per week, with some respondents reporting to consuming crab 4 times per week. The Natural Resources Defense Council calculated total daily consumption rates in grams(g)/day for all respondents and found that the median daily consumption for the study as a whole was 48g/day, respondents from Louisiana rural coastal communities was 53.3g/day, and respondents from Vietnamese-American communities in Louisiana and Mississippi was 64g/day. All consumption rates exceeded the Food and Drug Administration's assumptions. In Gulf coastal areas, low-income and minority groups are heavy subsistence users of local seafood. The concern is that heavy subsistence users face higher than expected, and potentially harmful, exposure rates to PAH's from the DWH event. In a study following the *MV Erika* spill off the coast of France, rats were fed oil-contaminated mussels daily for 2 and 4 weeks. No evidence of genotoxicity was observed in the blood samples, although significant increases in DNA damage were observed in the liver and the bone marrow of the rats. The intensity of the DNA damage increased with the PAH contamination level of the mussels (Aguilera et al., 2010). Actual levels of exposure are unknown as are the potential health effects from higher than expected exposure, but State and local health monitoring and Federal health studies are either ongoing or in the proposal phase (Mackar, 2010).

Summary and Conclusion

Chemical and drilling-fluid spills may be associated with exploration, production, or transportation activities that result from the WPA proposed action. Low-income and minority populations might be more sensitive to oil spills in coastal waters than is the general population because of their dietary reliance on wild coastal resources, their reliance on these resources for other subsistence purposes such as sharing and bartering, their limited flexibility in substituting wild resources with purchased ones, and their likelihood of participating in cleanup efforts and other mitigating activities. With the exception of a catastrophic accidental event, such as the DWH event, the impacts of oil spills, vessel collisions, and chemical/drilling fluid spills are not likely to be of sufficient duration to have adverse and disproportionate long-term effects for low-income and minority communities in the analysis area.

An event like the DWH event could have adverse and disproportionate effects for low-income and minority communities in the analysis area. Many of the long-term impacts of the DWH event to low-income and minority communities are unknown. While economic impacts have been partially mitigated by employers retaining employees for delayed maintenance or through the GCCF Program's emergency funds, the physical and mental health effects to both children and adults within these communities could potentially unfold for many years. As studies of past oil spills have highlighted, different cultural groups can possess varying capacities to cope with these types of events (Palinkas et al., 1992). Likewise, some low-income and/or minority groups may be more reliant on natural resources and/or less equipped to substitute contaminated or inaccessible natural resources with private market offerings. Because lower-income and/or minority communities may live near and directly involved with spill cleanup efforts, the vectors of exposure can be higher for them than for the general population, increasing the potential risks of long-term health affects. To date, there have been no longitudinal epidemiological studies of possible long-term health effects for oil-spill cleanup workers. The post-DWH event human environment remains dynamic, and BOEMRE will continue to monitor these populations over time and to document short- and long-term DWH event impacts. In the future, the long-term impacts of the DWH event will be clearer as time allows the production of peer-reviewed research and targeted studies that determine those impacts.

The DWH event was a low-probability, high-impact catastrophic event. For the reasons set forth in the analysis above, the kinds of accidental events (smaller, shorter time scale) that are likely to result from proposed WPA Lease Sale 218 may affect low-income and/or minority more than the general population, at least in the shorter term. These higher risk groups may lack the financial or social resources and may be more sensitive and less equipped to cope with the disruption these events pose. These smaller events, however, are not likely to significantly affect minority and low-income communities in the long term.

4.1.1.18.4.4. Cumulative Impacts

Background/Introduction

An impact analysis for cumulative impacts in the WPA and CPA on environmental justice can be found in Chapter 4.5.15.4 of the Multisale EIS. Impact analyses for the WPA and CPA that includes any new information since publication of the Multisale EIS is presented in Chapter 4.1.16.4.4 of the 2009-

2012 Supplemental EIS. The following information is a summary of the cumulative impact analysis incorporated from the Multisale EIS and the Supplemental EIS, and new information that has become available since both documents were prepared.

Of all activities in the cumulative scenario, those that could potentially impact environmental justice in the WPA include (1) proposed actions and the OCS Program, (2) State oil and gas activity, (3) existing infrastructure associated with petrochemical processing including refineries and polyvinyl plants, (4) existing waste facilities including landfills, (5) coastal erosion/subsidence, (6) hurricanes, (7) global climate change, and (8) the lingering impacts of the DWH event. The context in which people may find themselves, and how that context affects their ability to respond to an additional change in the socioeconomic or physical environment, is the heart of an environmental justice analysis. The OCS Program in the GOM is large and has been ongoing for more than 50 years, with established infrastructure, resources, and labor pools to accommodate it. That said, low-income and/or minority groups lacking financial, social, or environmental resources or practical alternatives may be more sensitive to, or are less equipped than are other groups, to cope with consequences of an oil spill, such as interruptions to municipal services or to fisheries closures. In studies on social disaster resiliency, variables such as income inequality can negatively impact a community's ability to respond, and recover, from a disaster (Norris et al., 2008). Groups may be even less equipped to respond to these types of events if, for example, they are already in the process of recovering from a hurricane. On the other hand, Cutter et al. (2008) found that previous disaster experience, defined as the number of paid disaster declarations, positively affected disaster resilience. This cumulative impact analysis examines how incremental additions to an established program from the proposed WPA Lease Sale 218 area potentially may interact within these ongoing external impacts along the Gulf Coast. As explained in prior sections, the interlinked nature of the OCS industry requires a discussion of potential impacts both in the WPA and the CPA.

OCS Program

Proposed WPA Lease Sale 218 and the OCS Program have the potential to adversely impact low-income, minority, and other environmental justice communities either directly or indirectly from onshore activities conducted in support of OCS exploration, development, and production (for a fuller discussion on potential impacts from routine events and accidental events, see **Chapters 4.1.1.18.4.2 and 4.1.1.18.4.3**, respectively). Potential vectors for impacts include increases in onshore activity (such as employment, migration, commuter traffic, and truck traffic), additions to the infrastructure supporting this activity (such as fabrication yards, supply ports, and onshore disposal sites for offshore waste), and additional accidental events such as oil or chemical spills. The BOEMRE estimates that production from the WPA proposed action would be 0.222-0.423 BBO and 1.495-2.647 Tcf of gas and that production for both the CPA and WPA proposed actions would range from 28.562 to 32.57 BBO and 142.366 to 162.722 Tcf of gas during 2007-2046 (**Table 3-1**). **Chapter 3.3.1** describes the widespread and extensive OCS-support system and associated labor force, as well as economic factors related to OCS activities. The widespread nature of the OCS-related infrastructure serves to limit the magnitude of effects that a single proposed action or the overall OCS Program may have on any particular community. Future lease sales would serve mostly to maintain the ongoing activity levels associated with the current OCS Program.

For most of the Gulf Coast, the OCS Program would result in only minor economic changes. Generally, effects would be widely yet thinly distributed across the Gulf Coast and would consist of slight increases in employment and few, if any, increases in population. Some places could experience elevated employment, population, infrastructure, and/or traffic effects because of local concentrations of fabrication and supply operations. Because of Louisiana's extensive oil-related support system (**Chapter 4.1.18.1**), that State is likely to experience more employment effects related to the WPA proposed action than are the other coastal states. Because Lafourche Parish, Louisiana, already services about 90 percent of all deepwater oil production and 45 percent of all shallow-water oil and gas production in the Gulf, it is likely to continue experiencing benefits from the OCS Program (Loren C. Scott & Associates, 2008). While the addition of the C-Port in Galveston, Texas, is expected to increase Texas's share of future effects, Louisiana is likely to continue to experience more than the other Gulf Coast States. Except in Louisiana, the OCS Program is expected to provide little additional employment, although it would serve to maintain current activity levels, which is expected to be beneficial to Gulf region low-income and minority populations generally. The Multisale EIS stated the following: "Evidence also suggests that a healthy offshore petroleum industry also indirectly benefits low-income and minority populations." One Agency study found income inequality in Louisiana decreased during the oil boom and increased with the decline (Tolbert, 1995).

Environmental justice often concerns infrastructure siting, which may have disproportionate and negative effects on minority and low-income populations. Since OCS lease sales help maintain ongoing levels of activity rather than expand them, no one sale would generate significant new infrastructure demand. Pipeline shore facilities are small structures, such as oil metering stations, associated with pipeline landfalls. At present, there are 126 OCS-related pipeline landfalls and 50 OCS-related pipeline shore facilities in the GOM region (Table 3-38 of the Multisale EIS). Up to one new pipeline and up to one onshore facility are projected for the proposed action. Cumulatively, over the next 40 years, the OCS Program is expected to result in 32-47 new pipeline landfalls, and 4-6 pipeline shore facilities are projected (Table 4-9 of the Multisale EIS). From 25 to 36 landfalls are projected for Louisiana, which currently has 106; 6-8 are projected for Texas, which currently has 13; 1-3 are projected for Mississippi and Alabama, which currently have 7; and 0 are projected for Florida. From 3 to 5 pipeline shore facilities are projected for Louisiana, which currently has 37; 1-2 are projected for Texas, which currently has 13; 0-1 are projected for Mississippi and Alabama, which currently have 0; and 0 for Florida. Each OCS-related facility that may be constructed onshore must receive approval by the relevant Federal, State, and local agencies. Each onshore pipeline must obtain similar permit approval and concurrence. The BOEMRE assumes that all such approval would be consistent with appropriate land-use plans, zoning regulations, and other Federal/State/regional/local regulatory mechanisms. Should a conflict occur, BOEMRE assumes that approval would not be granted or that appropriate mitigating measures would be enforced by the responsible political entities.

As stated in **Chapter 4.1.1.18.4.1** and displayed in Figures 3-21 through 3-26 of the Multisale EIS, the region as a whole is not homogenous, but there are several potentially vulnerable ethnic and socioeconomic groups, some residing in enclaves, dispersed throughout OCS Gulf of Mexico economic impact areas. It shows that 10 counties/parishes with high concentrations of oil-related infrastructure (Table 3-40 of the Multisale EIS) are not generally those with high concentrations of minority and low-income populations and that, in these counties/parishes, many of the low-income and minority populations reside in large urban areas where the complexity and dynamism of the economy and labor force preclude a measurable sale-level or programmatic-level OCS effects.

Two local infrastructure issues analyzed in **Chapter 4.1.1.18.4.1** could possibly have related environmental justice concerns: traffic on LA Hwy 1 and the Port Fourchon expansion. This analysis concludes that the minority and low-income populations of Lafourche Parish would share the negative impacts of the OCS Program with the rest of the population. However, most effects are expected to be economic and positive. It is likely that a proposed 27.5 mi (44.3 km) of improvements to the Port Fourchon highway system will be funded in the next few years, alleviating many of the associated issues with the highway.

While there is a link between a healthy oil industry and indirect economic benefits to all sectors of society, this link may be weak in some communities and strong in others, such as Lafourche Parish, Louisiana (Hughes et al., 2001). Even in these areas, the petroleum industry has not been a critical factor in social change, except for limited periods of time (Wallace et al., 2001). This is the conclusion of this Agency's 5-Year Programmatic EIS (USDOI, MMS, 2001b), which analyzed the contribution of the OCS Program in the GOM (i.e., its cumulative effects) to the cumulative factors affecting environmental justice. Impacts, including how communities respond to fluctuations in industry activity, vary from one coastal community to the next. Expansion or contraction of offshore or onshore oil and gas activity has produced moderate impacts in some communities, whereas other communities have dealt with episodes of rapid industry change with negligible to minor impact. Furthermore, non-OCS activities, such as expansions of the tourism industry or the highway system, often can generate socioeconomic impacts by being a catalyst for such things as in-migration, demographic shifts, population change, job creation and cessation, community development strategies, and overall changes in social institutions (i.e., family, government, politics, education, and religion). Reflecting this Agency's earlier 5-Year Programmatic EIS analysis, this analysis concludes that the contribution of proposed WPA Lease Sale 218 to the OCS Program's cumulative environmental justice impacts would be negligible. The analysis also concludes that, overall, OCS programmatic impacts to environmental justice over the next 40 years would likely represent a very small proportion of the cumulative impacts all activities that affect environmental justice. The analysis also concludes that, overall, OCS programmatic impacts to environmental justice over the next 40 years would likely represent a very small proportion of the cumulative impacts of all activities that affect environmental justice.

State Oil and Gas

State oil and gas activity has the potential to adversely impact low-income, minority and other environmental justice communities either directly or indirectly from onshore activities conducted in support of State oil and gas exploration, development, and production. Louisiana, Mississippi, and Alabama jurisdiction over mineral resources extends 3 mi from the shore; Texas and the west coast of Florida jurisdiction over the seabed extends out 9 mi. Texas State-owned submerged lands are divided into three areas: the Upper Coast (Brazoria County, north to Orange County); the Middle Coast (Nueces County, north to Matagorda County); and the Lower Coast (Cameron County, north to Kleberg County) (Texas General Land Office, 2011). Texas manages a well-established oil and gas leasing program both onshore and offshore, using the 20-25 percent royalties collected from oil and gas production to partially fund the State's Permanent School Fund. The Fund provides an equitable level of funding for school districts across the state. State offshore oil and gas programs pose the same potential issues as does the OCS Program, although since State leases are closer to land, their petroleum-related activities are generally viewed as having greater potential for directly impacting coastal communities. The BOEMRE assumes that sitings of any future facilities associated with State programs would be based on the same economic, logistical, zoning, and permitting considerations that determined past sitings. Chapter 4.5.15.4 of the Multisale EIS noted that revenues from State water oil programs have produced several positive impacts and that the steady stream of oil exploration and development have produced positive cumulative impacts that include increased funding for infrastructure, higher incomes (that can be used to purchase better equipment for subsistence), better health care, and improved educational facilities. This is certainly true for Texas, which has historically used oil and gas revenues on State lands to equalize education district disparities across the state.

Downstream Activities

Existing onshore infrastructure associated with petrochemical processing including refineries and the production of petroleum-based goods such as polyvinyl plants poses potential health and other related risks to minority and low-income communities. The BOEMRE projects that cumulatively, 14 new gas processing plants would be needed in support of the OCS Program over the next 40 years. The marginal contribution of proposed WPA Lease Sale 218 does not change the estimate. The geographic distribution of projected gas processing plants differs markedly from the current distribution. Three new gas processing plants are projected for Louisiana, which currently has 28; 2 are projected for Texas, which currently has 1; and 9 are projected for Mississippi and Alabama, which currently have 6. As described in Chapter 3.3.5.8 of the Multisale EIS, this distribution is based on economic and logistical considerations unrelated to the distribution of concentrations of minority or low-income populations. The BOEMRE cannot predict and does not regulate the siting of future gas processing plants. The BOEMRE assumes that sitings of any future facilities would be based on the same economic, logistical, zoning, and permitting considerations that determined past sitings and that they would not disproportionately affect minority and low-income populations. An environmental justice study of industrial siting patterns in Jefferson, St. Bernard, and Lafourche Parishes, Louisiana, (Hemmerling and Colten, in preparation) found that "people appear to be moving into densely populated, largely industrial areas here the costs of rent are lower. In addition, people tend to be moving into newer housing." This historical analysis revealed little evidence of systematic environmental injustice of various oil-related industries, with the demographic makeup of the communities changing after facilities arrived. Communities with a higher than average number of chemical plants should be monitored to ensure that industry dominating the landscape does not disproportionately burden low-income or minority communities.

Public Health

The Natural Resources Defense Council and the National Disease Clusters Alliance identify and track disease clusters in the United States. An unusually large number of people sickened by a disease in a certain place and time is known as a "disease cluster" (Navarro et al., 2011). The underlying causes of a disease cluster are theorized to be genetic, environmental, or both. The Council and Alliance have identified two such clusters in the WPA (Houston and Nueces), and both have higher minority and lower income populations. Researchers from the University of Texas's School of Public Health found that children who live within 2 mi (3 km) of the Houston Ship Channel have a 56 percent greater chance of getting leukemia than children living elsewhere. The elevated rates of childhood leukemia were found in Census tracts with the highest benzene and 1,3-butadiene levels in the air. The Houston Ship Channel is the largest petrochemical complex in the United States, in addition to supporting a large number of industrial activities and vessel traffic. The second WPA county with an identified disease cluster is Nueces County, where in 2006 the Texas Department of State Health Services found the county had a birth defect rate that was 84 percent higher than the rest of Texas. Researchers were not able to find a direct link between rates of birth defects and several industrial sites in the county, although they found that mothers living near refineries and old chemical plants had babies with higher rates of life-threatening birth defects of the abdominal wall and diaphragm.

Due to the distance of OCS Program activities offshore, routine events related to the proposed action would not be expected to affect public health in these communities. Both of these sites are far from coastlines where an OCS Program-related oil spill could directly impact these people, but it is not unlikely that members of these communities could participate in cleanup efforts should such a spill occur. An environmental justice analysis seeks to identify populations that, through a variety of mechanisms, may become disproportionately impacted by the proposed action and associated activities. Research like this suggests that there may be a correlation between downstream oil and gas processing (after any OCS Program-related oil and gas comes ashore) and diminished health in adjacent populations. Communities with disease clusters are likely to be even more sensitive to potential impacts in a cumulative scenario.

Waste

Based on operator data provided in filed plans, BOEMRE estimates that there is an average of 2,000 cubic feet of trash and debris generated per exploration well drilled, 102 cubic feet of trash and debris generated per development well drilled, and 1,000 cubic feet of trash and debris generated per year per manned platform of its 25-year life (Dismukes et al., 2007). An entire sale usually represents less than 1 percent of the total current permitted landfill capacity in the GOM economic impact area. Because of technological improvements on how waste is compacted, landfill capacity has increased, with Texas landfills having increased useful life by 19 years form the mid-1990's to 2005. Drilling muds and wastewater streams can be used as landfill cover, and landfills will often accept these materials at a reduced price or even at no charge (The Louis Berger Group, 2004). The occurrence of hazardous offshore, oil-field waste is minimal and infrequent. Industry representatives contacted for a BOEMRE study indicated that the need for hazardous storage could occur as infrequently as once in 5 years for a typical offshore facility with drilling and production activities (Dismukes et al., 2007). **Table 4-43** displays where existing waste sites are located in relation to low-income and minority communities, as well as the distribution of waste from the DWH event between Gulf landfills and waste processing facilities. Argonne National Laboratory reported that there are 46 waste management facilities that service the oil and gas industry along the GOM, with 18 in Louisiana, 18 in Texas, 5 in Mississippi, 4 in Alabama, and 1 in Florida (Puder and Veil, 2006). Because of existing capacity, no new waste disposal sites are projected for the cumulative case (The Louis Berger Group, Inc., 2004). Therefore, no changes in impacts to minority and low-income communities are expected.

Coastal Erosion and Subsidence

Coastal erosion and subsidence in some parts of the southeastern coastal plain serves to amplify the vulnerability of communities, infrastructure, and natural resources to storm-surge flooding (Dalton and Jones, 2010). Submergence in the Gulf area is occurring most rapidly along the Louisiana coast and more slowly in other coastal states. Depending on local geologic conditions, the subsidence rate varies across coastal Louisiana from 3 to over 10 mm/yr (0.12 to over 0.39 in/yr). Natural drainage patterns along many areas of the Texas coast areas have been severely altered by construction of the Gulf Intracoastal Waterway and other channelization projects associated with its development. Saltwater intrusion resulting from river channelization and canal dredging is a major cause of coastal habitat deterioration (Tiner, 1984; National Wetlands Inventory Group, 1985; Cox et al., 1997); see **Chapter 4.1.1.4** for a discussion of wetlands in the WPA. As discussed in **Chapter 4.1.1.18.4.1,** tropical storms may be the norm in the region, but low-income and minority communities may bear a larger burden than the general populations. Native Americans, Vietnamese, Cajun, African American, and other ethnic enclaves have all borne catastrophic losses in recent storm events. An estimated 4,500 Native Americans living on the southeast Louisiana coast lost their possessions to Hurricane Katrina, according to State officials and tribal leaders. Cajuns were also impacted by Hurricane Katrina, and especially by Hurricane Rita, whose 20-ft (6-m) storm surges flooded low-lying communities in Cameron, Calcasieu, and other coastal parishes. According to a USGS 5-year, post-Katrina survey, the wetland loss from all four storms (Hurricanes Katrina, Rita , Gustav, and Ike) totaled 340 mi^2 (881 km^2).

Coastal subsidence, sea level rise and erosion can increase community vulnerability to future hazards and also threaten traditional ways of life. Saltwater intrusion reduces the productivity and species diversity associated with Louisiana and Texas wetlands coastal marshes (Stutzenbaker and Weller, 1989; Cox et al., 1997). While users of coastal waters may trend towards the relatively affluent, low-income and minority groups may be more dependent on the resources of the Gulf Coast. Several ethnic minority and low-income groups rely substantially on these resources (e.g., see Hemmerling and Colten, 2003, for an evaluation of environmental justice considerations for south Lafourche Parish).

Coastal Storms

Hurricanes, tropical storms, and other wind-driven tidal or storm events are a fact of life for communities living along the Gulf of Mexico coastal zone. For low-income and minority populations, however, the impacts of coastal storm events can be particularly profound because of factors like limited resources to evacuate or to mitigate hazards. Baseline conditions pertaining to environmental justice were reevaluated in light of recent hurricane activity in the GOM. The intensity and frequency of hurricanes in the Gulf over the last 6 years has greatly impacted the system of protective barrier islands, beaches, and dunes and associated wetlands along the Gulf Coast. Within the last 7 years, the Gulf Coast of Texas, Louisiana, Mississippi, Alabama, and to some degree Florida have experienced five major hurricanes (Ivan, Katrina, Rita, Gustav, and Ike). Impacts from future hurricanes and tropical storm events are uncertain. One study found that neighborhoods with higher proportions of renters, households in poverty, and minorities were more likely to have waited to evacuate the urbanized barrier island in advance of Hurricane Ike (Van Zandt et al., 2010). Municipal programs like the New Orleans Office of Homeland Security and Public Safety's City Assisted Evacuation Plan are being implemented to help citizens who want to evacuate during an emergency but lack the capability to self-evacuate (City of New Orleans, n.d.). Hazard mitigation funds available through individual states and FEMA also seek to mitigate potential damage to homes in flood zones throughout the Gulf. While hurricanes and tropical storms are inevitable, lessons learned from Hurricanes Katrina and Rita are shaping local and national policies as well as nongovernmental organizations efforts to protect low-income, minority, and other vulnerable communities.

Deepwater Horizon *Event*

While it is still too soon to determine the long-term social impacts of the DWH event, anecdotal evidence from media coverage and early survey studies suggest the possibility of trends that might disproportionately affect low-income and minority communities for some time to come. A phone survey conducted by a team of Louisiana State University sociologists found that nearly 60 percent of the 925 coastal Louisiana residents interviewed reported being almost constantly worried by the DWH event (Lee and Blanchard, 2010). Studies of residents near past oil spills (such as the *Exxon Valdez* in Prince William Sound, Alaska) have noted impacts to social cohesion and increased distrust in government and other institutions, which contributed to community anxiety (Tuler et al., 2009).

Cumulative effects on social organization could include decreasing importance of the family, cooperation, sharing, and subsistence availability. Long-term effects on wild resource harvest patterns might also be expected. While acute health effects from oil-spill events have been somewhat studied, the long-term impacts from exposure is unknown (Aguilera et al., 2010; Meo, 2009; Morita et al., 1999; Sathiakumar, 2010). Longitudinal epidemiological studies of possible long-term health effects from exposure to either the DWH event's oil or dispersants, such as the possible bioaccumulation of toxins in tissues and organs, are lacking, and the potential for the long-term human health effects are largely unknown (although the National Institutes of Health has proposed such a study). In prior post-spill cleanup efforts, the duration of cleaning work was a risk factor for acute toxic symptoms, and seamen had the highest occurrence of toxic symptoms compared with volunteers or paid workers (Sathiakumar, 2010). Therefore, participants in the DWH "Vessels of Opportunity" program, which recruited local boat owners (including Cajun, Houma Indian, and Vietnamese fishermen) to assist in cleanup efforts, would likely be one of the most exposed groups. African Americans are thought to have made up a high percentage of the cleanup workforce. In Gulf coastal areas, low-income and minority groups are heavy subsistence users of local seafood. The concern is that heavy subsistence users face higher than expected, and potentially harmful, exposure rates to PAH's from the DWH event. As mentioned earlier, the National Institutes of Health's proposed study should provide a better understanding of the long-term and cumulative health impacts, such as the consequences of working close to a spill and of consuming contaminated seafood. Several ongoing studies also seek to understand the short- and long-term impacts of the recent DWH event (e.g., the study "Ethnic Groups and Enclaves Affected by OCS," which was launched August 1, 2010). Information regarding the impacts of the DWH event remains incomplete at this time. Studies regarding environmental justice concerns in light of the DWH event are only in their infancy, and it may be years before data are available and certainly not within the timeframe of this NEPA analysis. The NRDA process, which is ongoing, may help to inform issues relating to subsistence and other indigenous reliance on natural resources. This information is unavailable and unobtainable at this time, regardless of costs. In its places, the subject-matter experts have used credible information that is available and applied using accepted socioeconomic methodologies. Although most criteria related to environmental justice may not be essential to a reasoned choice among the alternatives, health impacts would generally be essential. Nevertheless, long-term health studies are pending and may not be available for use for several years or longer. What credible information is available was applied using accepted methodologies in the health analysis below. The BOEMRE will continue to seek additional information as it becomes available.

Summary and Conclusion

The cumulative impacts of proposed WPA Lease Sale 218 would occur within the context of other impact-producing factors on environmental justice, including (1) proposed actions and the OCS Program, (2) State oil and gas activity, (3) existing infrastructure associated with petrochemical processing including refineries and polyvinyl plants, (4) existing waste facilities including landfill, (5) coastal erosion/subsidence, (6) hurricanes, (7) global climate change, and (8) the lingering impacts of the DWH event.

Because of the presence of an extensive and widespread support system for the OCS and associated labor force, the effects of the cumulative case are expected to be widely distributed and, except in Louisiana, little felt. In general, the cumulative effects of the OCS Program are expected to be economic and to have a limited but positive effect on low-income and minority populations. In Louisiana, these positive economic effects are expected to be greater. In general, who would be hired and where new infrastructure might be located is impossible to predict, although a new C-Port in Galveston, Texas, is likely to increase Texas' share of effects. Given the existing distribution of the OCS-related industry and the limited concentrations of minority and low-income peoples, the cumulative OCS Program would not have a disproportionate effect on these populations. Lafourche Parish would experience the most concentrated effects of cumulative impacts. Because the parish is not heavily low-income or minority and because the effects of road traffic and port expansion would not occur in areas of low-income or minority concentration, these groups are not expected to be differentially affected.

To summarize, the WPA proposed action is not expected to have disproportionate high/adverse environmental or health effects on minority or low-income people, and in the GOM coastal area, the contribution of the proposed action and the OCS Program to the cumulative effects of all activities and trends affecting environmental justice issues over the next 40 years is expected to be negligible to minor.

The cumulative effects would be concentrated in coastal areas, and particularly Louisiana. Most OCS Program effects are expected to be in the areas of job creation and the stimulation of the economy, and they are expected to make a positive contribution to environmental justice. The contribution of the cumulative OCS Program to the cumulative impacts of all factors affecting environmental justice is expected to be minor (USDOI, MMS, 2001b); therefore, the incremental contribution of the WPA proposed action to the cumulative impacts would also be minor. State offshore leasing programs in Alabama and Louisiana have similar, although more limited, effects due to their smaller scale. Cumulative effects from onshore infrastructure, including waste facilities, is also expected to be minor because existing infrastructure is regulated, because little new infrastructure is expected to result in the cumulative case, and because any new infrastructure would be subject to relevant permitting requirements. Coastal landloss/subsidence, hurricanes, and global warming all raise environmental justice issues, as do the lingering effects of the DWH event. The cumulative consequences to environmental justice cannot be determined at this time. Nevertheless, a single OCS lease sale added to existing State and Federal leasing programs and onshore infrastructure would make only minor contributions to these cumulative effects.

4.1.1.19. Additional Resources Considered due to the Deepwater Horizon Event

The following resources, i.e., soft bottoms and diamondback terrapins, have not been included in previous EIS's due to the negligible impacts to these resources from routine impact-producing factors associated with OCS-related activities. The BOEMRE has included these resources in this Supplemental EIS primarily to address concerns about the potential impacts of the DWH event and resulting oil spill to these resources.

4.1.1.19.1. Soft Bottoms

4.1.1.19.1.1. Description of the Affected Environment

The seafloor on the continental shelf in the Gulf of Mexico consists primarily of muddy to sandy sediments. Sediments of the western shelf are a mixture of sand, silt, and clay. Quartz sand is present in nearshore waters off Galveston and Port Arthur and offshore of Corpus Christi south to Brownsville, Texas, which changes to silt and clay offshore (Ellwood et al., 2006; Balsam and Beeson, 2003). The South Texas OCS is primarily fine sandy sediment on the inner shelf and fines toward the outer shelf to silts and clays (Behrens et al., 1980; Rabalais, 1990). The remainder of this shelf is comprised of terrigenous silt and clay (Ellwood et al., 2006; Balsam and Beeson, 2003).

Benthic fauna include infauna (animals that live in the substrate, including mostly burrowing worms, crustaceans, and mollusks) and epifauna (animals that live on or are attached to the substrate; mostly crustaceans, as well as echinoderms, mollusks, hydroids, sponges, soft and hard corals, and demersal fishes). Infauna is comprised of meiofauna, small organisms (63-500 µ) that live among the grains of sediment; and macroinfauna, slightly larger organisms (>0.5 mm; 0.02 in) that live in the sediment (Dames & Moore, Inc., 1979). Shrimp and demersal fish are closely associated with the benthic community. The most abundant organisms on the continental shelf are the deposit-feeding polychaetes. The slope and deep sea consist of vast areas of primarily fine sediments that support benthic communities with lower densities and biomass but higher diversity than the continental shelf (Rowe and Kennicutt, 2001). The following information is an entirely new section since the writing of the Multisale EIS and the 2009-2012 Supplemental EIS and is described in full.

Environmental Influences on Benthic Community Structure

Substrate is the single most important factor in the distribution of benthic fauna (densities of infaunal organisms increase with sediment particle size), although temperature and salinity are also important in determining the extent of faunal distribution (Vittor, 2000; Byrnes et al., 1999; Harper, 1991; Dames & Moore, Inc., 1979; Parker et al., 1975; Barry A. Vittor & Associates Inc., 1985; Defenbaugh, 1976). Depth and distance from shore also influence the benthic faunal distribution (Harper, 1991; Dames & Moore, Inc., 1979; Defenbaugh, 1976; Parker et al., 1975). Lesser important factors include illumination, food availability, currents, tides, and wave shock. Experiments indicate that fluctuating physical factors have a greater influence in estuaries than farther offshore, where sediment type is the primary influencing factor (Flemer et al., 2002).

Substrate type, as the most important control upon benthic infaunal assemblages, has been emphasized by previous sampling efforts over broad areas of the northern Gulf of Mexico shelf. Studies of the infauna of the South Texas OCS revealed that continental shelf benthic habitats can be described primarily on the basis of sediment texture and water depth (Parker et al., 1975; Powell et al., 1980; Rabalais, 1990). Vittor (2000) categorized the OCS of the northern Gulf of Mexico based on sediment types and species associated with those habitats.

Infaunal assemblages are comprised of species adapted to particular sedimentary habitats through differences in behavioral, morphological, physiological, and reproductive characteristics. Feeding is one of the behavioral aspects most closely related to sedimentary habitat (Rhoads, 1974). In general, habitats with coarse sediment and high water current velocities, where organic particles are maintained in suspension in the water column, favor the occurrence of suspension-feeding taxa that strain food particles from the water column. Coarse sediments also facilitate the feeding of carnivorous taxa that consume organisms occupying interstitial habitats (Fauchald and Jumars, 1979). At the other extreme, habitats with fine-textured sediments and little or no current are characterized by the deposition and accumulation of organic material, thereby favoring the occurrence of surface and subsurface deposit-feeding taxa. In between these habitat extremes are a variety of habitat types that differ with respect to various combinations of sedimentary regime, depth, and hydrological factors, with each habitat type facilitating the existence of particular infaunal assemblages (Barry A. Vittor & Associates, Inc., 1985).

Descriptions of Continental Shelf Soft-Bottom Benthic Communities

Vittor (2000) described the general community composition of the infaunal habitats on the OCS of the northern Gulf of Mexico. He described the communities primarily based on sediment type and distance from shore and grouped the inhabitants by feeding mode.

- Assemblage I consisted of sandy sediments (<5% silt/clay or gravel) spread along the entire continental shelf. Dominant filter feeders on the shelf were mollusks (*Astarte nana*, *Chione intapurpurea*, *Ervilia concentrica*, *Tellina aequistriata*). Deposit feeders included mollusks (*Caecum cooperi*, *Caecum imbricatum, Cadulus tetrodon*) and ostracods (*Rutiderma darbyi*). Carnivores included polychaetes (*Nephtys picta*, *Sigambra tentaculata*, *Synelims albini*) and mollusks (*Nassarius albus, Tectonatica pusilla*).
- Assemblage II consisted of silty sand and sandy silt on the inner shelf in less than 100 m (328 ft) of water. These areas generally have greater than 5 percent or 10 percent silt and are affected by sediment transport from estuaries. Burrowing and surface deposit-feeding polychaete detritivores such as *Armandia maculata*, *Dispio uncinata*, *Magelona petiboneae*, *Paraprionospio pinnata*, and *Spiophanes bombyx* inhabit this habitat. Filter-feeding crustaceans (*Ampelisca agassizi*, *Branchiostoma* sp.) and polychaetes (*Diopatra cuprea*, *Owenia fusiformis*) are also abundant.
- Assemblage III is comprised of patchy coarse sand or gravel. Deposit feeders in this group include mollusks (*Caecum cooperi*), amphipods (*Metharpinia floridana*), tanaids (*Apseudes* sp.), and polychaetes (*Aonides paucibranchiata*, *Chone duneri*, and *Filograna implexa*). *Chloeia viridis*, *Eunice vittata*, *Nephtys picta*, and *Bhawania heteroseta* are resident carnivores.
- Assemblage IV is comprised of fine and silty sand habitats in >100 m (328 ft) of water. The most abundant organisms are the burrowing and surface deposit feeders including polychaetes (*Ampharete acutifrons*, *Aricidea neosuecica*, *Armandia maculata*, *Laonice cirrata*, *Poecilochaetus johnsoni*) and mollusks (*Nuculana acuta*, *Yoldia liorhina*). Polychaete carnivores/omnivores also include *Goniada maculata*, *Paralacydonia paradoxa*, and *Synelmis albini*.

A study conducted by Texas A&M and Rice University on the Texas OCS identified benthic infaunal and epifaunal invertebrates common to the region. Infaunal organisms that were very common along the shelf included polycheates (*Paraprionospio pinnata* and *Nereis* sp.) and the amphipod, *Ampelisca agassiz* (Parker et al., 1975). Less common species encountered were the polychaetes *Armandia maculata*, *Mediomastus californiensis*, *Tharyx setigera*, *Cossura delta*, and *Ninoe nigripes*. Infaunal species appeared to be influenced by sediment grain size. Species numbers and abundance decreased with increasing distance from shore as the sand component of the sediment decreased and fine material increased with distance from shore (Parker et al., 1975).

Ubiquitous epifauna include shrimp (*Solenocera vioscai*, *Penaeus aztecus*, *Trachypenaeus similis*, and *Sicyonia dorsalis*) and the lesser blue crab (*Callinectes similis*) (Parker et al., 1975). Less common species that were collected include the paper scallop (*Amusium papyraceus*), mantis shrimp (*Squilla chydea*), deepwater rose shrimp (*Parapenaeus longirostris*), longspine swimming crab (*Portunus spinicarpus*) two-spined star fish (*Astropecten duplicates*), and sand dollar (*Brissiopsis alta*). Epifauna did not appear to be limited by sediment grain size, although some species were limited by water depth (Parker et al., 1975).

A 2-year program sponsored by the Bureau of Land Management included studies of the benthic communities on the South Texas OCS (Flint and Rabalais, 1980; Rabalais, 1990). Research was conducted between Pass Cavallo and Matagorda Bay Complex and the U.S.-Mexico border (Rabalais, 1990). These studies revealed that the South Texas OCS is primarily fine sandy sediment on the inner shelf and fines toward the outer shelf to silts and clays (Behrens et al., 1980; Rabalais, 1990). There are fewer hard-bottom features on the South Texas OCS than other portions of the northern Gulf of Mexico, and coarse sediments are associated with ancestral deltas and wave action (Behrens et al., 1980; Rabalais, 1990).

Polychaete worms, which are deposit feeders that feed on the fine sediments, dominate the benthic community throughout the entire shelf (Powell et al., 1980). Sediment grain size was the main determining factor in the benthic communities offshore (Rabalais, 1990). The number of species, organism diversity, and species diversity are greatest nearshore and decrease offshore. However, a few opportunistic species dominate inshore communities, while populations are more evenly distributed father offshore (Powell et al., 1980). This is because the inner shelf is more subject to disturbance than the outer shelf, which is more stable. Nematodes heavily dominated the meiofauna and were most abundant on the southern nearshore shelf (Rabalais, 1990).

The epifaunal species found on the Texas OCS do not show trends as infaunal species do because they are mobile and move throughout the shelf (Powell et al., 1980). Shallow-water communities, which are dominated by mobile decapods, however, do have seasonal population changes. The outer shelf has a high number of species but a low abundance of organisms (Powell et al., 1980).

Non-OCS Oil and Gas Program Threats to Benthic Communities

The benthic communities are threatened by two natural environmental perturbations that occur on the Texas-Louisiana continental shelf: hypoxic to anoxic bottom conditions and tropical storms. Hypoxic conditions occur annually with inconsistent intensities and ranges (Rabalais et al., 2002). On average, one tropical storm of varying intensity occurs on the Texas-Louisiana continental shelf every 4 years (Stone, 2001).

The Gulf of Mexico hypoxic zone is a band that stretches along the Texas-Louisiana shelf each summer where the dissolved oxygen concentrations are less than 2 ppm. It is one of the largest hypoxic areas in the world's coastal waters. The hypoxic zone is the result of excess nutrients, primarily nitrogen, in the water. More than half the nitrogen comes from nonpoint sources about the confluence of the Ohio and Mississippi Rivers. A large variability in river discharge exists from year to year (Nowlin et al., 1998). Measurements of suspended particulate matter in the area of the proposed action have found concentrations from <1 to 10 mg/L. The rivers' effects on temperature and salinity have been detected as far west as Galveston (Murray and Donley, 1996).

Storms can physically affect shallow-bottom environments, causing an increase in sedimentation, a rapid change in salinity or dissolved oxygen levels, storm surge scouring, and remobilization of contaminants in the sediment (Engle et al., 2008). Storms have also been shown to uproot benthic organisms from the sediment and suspend them in the water column (Dobbs and Vozarik, 1983). Studies conducted in the coastal waters of Louisiana, Mississippi, and Alabama 2 months after the passing of Hurricane Katrina revealed a significant decrease in the number of species, species diversity, and species density (Engle et al., 2008). The opportunistic polychaetes *Mediomastus ambiseta* and *Paraprionospio pinnata* dominated benthic communities 2 months after the storm, and some other species were completely missing from the community (Engle et al., 2008). Evidence shows that communities are not completely restructured after a storm event, but there may be a dominance shift, at least temporarily (Dobbs and Vozarik, 1983).

The frequent disturbances on the inner shelf cause the infaunal community to be dynamic and unstable and to remain at an immature level of development, compared with a mature and stable community comprised of large, deep-dwelling, head-down deposit feeders. Transitional taxa are able to numerically dominate habitats that experience various perturbations, including siltation, low salinity, and low levels of dissolved oxygen (hypoxia) (Thistle, 1981; Rabalais et al., 2002). Recolonization of depurated areas by populations from unaffected, neighboring, soft-bottom substrate would be expected to occur within a relatively short period of time (Dubois et al., 2009; Thistle, 1981). Initial repopulation from nearby stocks may begin with subsequent recruitment or immigration events and may be predominantly comprised of pioneering species, such as tube-dwelling polychaetes or oligochaetes (Rhodes and Germano, 1982). Full recovery will follow as later stages of successional communities overtake the opportunistic species (Rhodes and Germano, 1982), but the time it takes to reach a climax community may vary depending on the species and degree of impact. This environmental unpredictability selects for opportunistic organisms that rapidly reach sexual maturity and produce large quantities of offspring repeatedly throughout the year. Species requiring an extended growth and development period or more constant environmental conditions may not survive to maturity. These environmental threats tend to produce communities with lower biodiversity and biomass since longer-lived species tend to be eliminated.

Deepwater Horizon **Event Impacts on Soft-Bottom Benthic Communities**

It is highly unlikely that the soft-bottom benthic communities of the WPA would be impacted by the DWH event because of their distance from the event. The Macondo well, however, was located more than 300 mi (483 km) from the eastern boundary of the WPA, and NOAA has estimated that the most western extent of visible sheens related to oil from the DWH event extended no farther than Cameron Parish, Louisiana, to the east of the WPA boundary (**Figure 1-2**). Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). If any impacts do occur, they would be a result of low-level or long-term exposure to dispersed sedimented oil. Impacts may include reduced recruitment success and shift in community dominance. Although it is highly unlikely that the benthic communities of WPA were exposed to oil, discussions of possible impacts as a result of exposure are included in this section because there is no data to indicate conclusive evidence that exposure did not and will not occur. This information will likely be developed through the NRDA process. It may be years before this information becomes available, and certainly not within the timeframe of this Supplemental EIS process. Although this information may be relevant to reasonably foreseeable adverse effects on soft bottoms in the WPA, this information remains incomplete or unavailable at this time, regardless of the costs that would otherwise be necessary to obtain this information. What credible scientific information is available was applied using accepted methodologies. Regardless, complete data are not essential to a reasoned choice among the alternatives because of the distance of the WPA from the most western extent of the sheen and plume from the Macondo well (making any impacts extremely remote), and the fact that even if there were impacts, soft bottoms and their associated species regenerate quickly.

The following sections contain all new data since the Multisale EIS and the 2009-2012 Supplemental EIS were prepared. Extensive literature, Internet, and database searches have been conducted for results of scientific data on soft-bottom benthic communities following the DWH event. Although many research cruises have occurred, very few reports containing data have been released as of the writing of this document. Descriptions of studies completed or in progress are discussed and any results indicated are included. Also, because the impacts of the oil spill are not yet known, possible impacts to soft-bottom benthic communities as a result of oil exposure are discussed.

As discussed earlier, the majority of the seafloor of the Gulf of Mexico is covered in soft sediments. Oil released from the DWH event may have impacted some of the organisms that live on or in these sediments. Direct contact with high concentrations of oil may have resulted in acute toxicity to organisms, and lower concentration exposures may have resulted in sublethal impacts such as altered reproduction, growth, respiration, excretion, chemoreception, feeding, movement, stimulus response, and susceptibility to disease (Suchanek, 1993). These impacts may occur through exposure pathways at the sediment/water interface or in the sediment itself.

It is important to note that the effects of oil exposure to soft-bottom benthos are anticipated to have only impacted a very small portion of the seafloor of the Gulf of Mexico, and it is believed to have been limited to the CPA and farther east. Although approximately 4.9 million barrels of oil were released into the Gulf waters, not all of that oil reached the seafloor. As of November 2010, it is estimated that 26 percent of the released oil remained in the environment as oil on or just below the water surface as a light sheen or tarballs, oil that was washed ashore or collected from the shore, and oil that was in the sediments (Lubchenco et al., 2010). Currently, the bulk deposits of oil have been removed from beaches, and the remaining oil that reached shorelines has been buried (e.g., through wave action and hurricanes) and is weathering over time (OSAT-2, 2011). Oil that has been deposited on the floor of the Gulf has also weathered (OSAT, 2010). This residual oil has been degrading over time. The greatest concentrations are expected to be near the wellhead and decrease with distance from the source. The modes of transport to the seafloor discussed below are anticipated to only deliver a small amount of oil to the seafloor with decreasing concentrations away from the well.

Water Column and Sediment Water Interface Exposure

Although a portion of the oil that was released rose to the sea surface, because the oil was ejected under pressure, oil droplets become entrained deep in the water column. The upward movement of the oil was reduced because methane in the oil was dissolved at the high underwater pressures, reducing the oil's buoyancy (Adcroft et al., 2010). The large oil droplets rose to the sea surface, but the smaller droplets, formed by vigorous turbulence in the plume and the subsea injection of dispersants, remained neutrally buoyant in the water column, creating a subsurface plume of oil (Adcroft et al., 2010). Oil droplets less than 100 μm (0.0036 in) in diameter remained in the water column for several months (Joint Analysis Group, 2010a). Organisms may have been exposed to oil droplets in the water column (if they are mobile) or at the seafloor/water interface.

Also, some chemically dispersed oil may have reached the seafloor, but presumably in very low concentrations. It is reported that chemically dispersed surface oil from the DWH event remained in the top 6 m (20 ft) of the water column where it mixed with surrounding waters and biodegraded (Lubchenco et al., 2010). Data from other studies on dispersant usage on surface plumes indicates that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a). Dispersant usage also reduces the oil's ability to stick to particles in the water column, minimizing the ability of dispersed surface oil to adsorb to particles and travel to the seafloor (McAuliffe et al., 1981a). Any dispersed oil that reached the seafloor from the water's surface during this event would be expected to be at very low concentrations (less than 1 ppm) (McAuliffe et al., 1981a).

Oil dispersed in the subsurface plume may have also reached the seafloor. However, as with the surface dispersed oil, concentrations reaching the seafloor would be extremely low. Concentrations of dispersed and dissolved oil in the subsea plume were reported to be in the part per million range or less and decrease with distance from the wellhead (Lubchenco et al., 2010; Adcroft et al., 2010; Joint Analysis Group, 2010a). A recent report documents damage to a deepwater coral community in an area that oil plume models predict as the direction of travel for subsea oil plumes from the DWH event. Results are still pending but it appears that a coral community about 15 m x 40 m (50 ft x 130 ft) in size was severely damaged and may have been the result of oil impacts (USDOI, BOEMRE, 2010j). A major difference between this occurrence and likely effects on soft bottoms is that the coral community forms structures that protrude up into the water column. These upright corals would be affected by a passing oil plume in a way that a typical smooth soft bottom would not. The oil plume would pass over smooth soft bottom, continuing the process of biodegradation in mid-water and continuing to be dispersed over a wide area. Dispersed oil may also come in contact with benthic organisms that move into the water column or at the sediment/water interface. However, during the passage of an oil plume, benthic filter or suspension feeders have the ability to simply withdraw into the substrate until water quality improves.

There is very little data available on the impacts of the DWH event on benthic communities. There is no data to date on the concentrations of hydrocarbons in sediments or on benthic community structure on the seafloor of the WPA after this event. There are, however, a few data available on hydrocarbons and dissolved oxygen levels in the water column. Water column data may be used to extrapolate the exposures benthic organisms may have experienced at the sediment/water interface.

Water samples collected by the R/V *Weatherbird* on May 23-26, 2010, located 40 nmi and 45 nmi (46 mi and 52 mi; 74 km and 83 km) northeast and 142 nmi (163 mi; 263 km) southeast of the DWH rig revealed that concentrations of total petroleum hydrocarbons in the water column were less than 0.5 ppm (Haddad and Murawski, 2010). The total petroleum hydrocarbons concentrations were generally higher near the water's surface and closer to the wellhead (Haddad and Murawski, 2010; Joint Analysis Group, 2010a). Concentrations of dispersed and dissolved oil in the subsea plume were reported to be in the parts-per-million range or less and decrease with distance from the wellhead (Lubchenco et al., 2010; Adcroft et al., 2010; Joint Analysis Group, 2010a).

The hydrocarbon concentrations in the water column and subsea plume were close to, and below, the values reported by others for dispersed oil in the water column after oil spills. McAuliffe et al. (1981a) reported dispersed oil concentrations between 1 and 3 ppm, 9 m (30 ft) below the sea surface, 1 hour after treatment with dispersant, and Lewis and Aurand (1997) reported dispersed oil concentrations <1 ppm, 10 m (33 ft) below the sea surface. Although McAuliffe et al. (1981a) and Lewis and Aurand (1997) did not address subsea plumes, the oil concentrations in the subsea plume appear to be similar to the concentrations reported from surface use of dispersants (Lubchenco et al., 2010; Adcroft et al., 2010; Joint Analysis Group, 2010a).

The available data suggest that the concentrations of oil in the water column were low and the oil was dispersed. These data points were collected a great distance from the WPA, indicating that hydrocarbon levels in the water column would be even more dispersed in the WPA, decreasing possible exposure levels to benthic organisms. These data suggest that, even if any benthic organisms in the WPA at the sediment/water interface were exposed to oil as a result of the DWH event, the concentrations were very low (in the part-per-million range or less).

Hypoxia from Oil Biodegradation

Reduced oxygen conditions, or hypoxia, caused by the presence of oil in the water column and resultant break down of petroleum hydrocarbons by bacteria was also a concern. Numerous stations were sampled throughout the Gulf of Mexico by several research vessels between May 8 and August 9, 2010. Measured dissolved oxygen levels never reached hypoxic conditions (1.4 ml/L or 2 mg/L) and in fact were never below 2.5 ml/L at any station sampled (Joint Analysis Group, 2010a and 2010b).

A subsea hydrocarbon plume, which generally trended southwest from the release at the wellhead, was discovered during sampling events (Joint Analysis Group, 2010a). Dissolved oxygen anomalies were measured at 1,000-1,400 m (3,281-4,593 ft) below the sea surface, which corresponded to the depths that hydrocarbons from the DWH event were located (Joint Analysis Group, 2010b). Models indicated that hypoxic levels may be reached in the subsea plume when methane is oxidized (Adcroft et al., 2010). Field measurements indicated that these dissolved oxygen depressions, however, did not approach hypoxic levels as of August 9, 2010 (Joint Analysis Group, 2010b). The dissolved oxygen levels in the water column did not appear to be decreasing over time, indicating that the oil was mixing with the surrounding oxygen-rich water (Joint Analysis Group, 2010b).

Dissolved oxygen measurements taken at the seafloor between May 15 and May 25 were between 4.0 and 5.0 ml/L (Joint Analysis Group, 2010a). Dissolved oxygen was toward the lower end of the measurements south and southwest of the wellhead and was toward the higher end to the north and northwest of the wellhead (Joint Analysis Group, 2010a). This is the most recent data released for dissolved oxygen levels on the seafloor at the time of this writing. Dissolved oxygen levels of this concentration are far above the hypoxic range (<1.4 ml/L) and are not anticipated to result in loss of the benthic population.

A yearly hypoxic event on the continental shelf of the northern Gulf of Mexico off the Mississippi and Atchafalaya Rivers result in bottom oxygen levels dropping below 1.4 ml/L (2 mg/L) for prolonged periods during the spring through late summer (Rabalais et al., 2002). This hypoxic event results in lower dissolved oxygen levels than what were measured in the water column and bottom waters as a result of the DWH event (Joint Analysis Group, 2010a and 2010b; Haddad and Murawski, 2010). The yearly hypoxia results in most of the benthic organisms leaving the area or dying; however, data indicates that the benthic colonies recolonize yearly after this event (Rabalais et al., 2002; Diaz and Solow, 1999). This pattern of yearly disturbance and recruitment favors opportunistic species (for organisms that die as a result of the hypoxia), resulting in a community composition that does not reach its climax.

Based on the above water column and seafloor data, benthic communities would not have been lost due to hypoxia caused by the DWH event. Naturally occurring, yearly events cause lower dissolved oxygen levels than what were recorded as a result of the DWH event. The yearly hypoxic zone would likely have occurred during the DWH event and resulting spill, with its typical effects. However, if any organisms were lost due to reduced oxygen levels caused by natural occurrences or by biodegradation of oil in the environment, they should recolonize the area similarly to the yearly hypoxic event.

Sedimented Oil (Oil Adsorbed to Sediments)

Some of the smaller suspended oil droplets resulting from forceful injection at depth could have been carried to the seafloor as a result of oil droplets sedimenting to suspended particles in the water column. Some portion of the oil treated with dispersant, although having less affinity for adhering to suspended sediment, may still have settled to the seafloor before completely biodegrading. Oiled sediment that settled to the seafloor may affect the underlying organisms. It is not yet known how much oil sedimented to particles and settled to the seafloor. If large amounts of oil made its way to the seafloor, the underlying benthic communities may have been smothered by the particles or exposed to toxic hydrocarbons. It is anticipated that the greatest concentration of sedimented oil occurred close to the well; oil would continue to disperse over wider areas with lower concentrations as it travels farther from the source (Haddad and Murawski, 2010; Joint Analysis Group, 2010a). Therefore, heavy loads of sedimented oil and possible resultant smothering effects are not expected in the WPA.

Acute Toxicity and Recovery

The greatest threat to the benthic communities is anticipated to be the sedimented oil that may reach the seafloor. Because oil concentrations decreased in the water column away from the well, the highest sedimented oil concentrations should be in areas closer to the well, far from the benthic communities in the WPA. Soft-bottom infaunal communities near the wellhead may have been negatively impacted by direct contact with sedimented oil and may experience sublethal (exposure) and/or lethal (smothering) effects.

Localized areas of lethal effects would be recolonized by populations from neighboring soft-bottom substrate once the oil in the sediment has been sufficiently reduced to support marine life (Sanders et al., 1980). Opportunistic species, such as tube-dwelling polychaetes or oligochaetes, would be the first to appear. These species would occur within the first recruitment cycle of the surrounding populations and from species immigrating from surrounding stocks (Rhodes and Germano, 1982). These pioneering species would maintain a stronghold in the area until community succession begins (Rhodes and Germano, 1982; Sanders et al., 1980). Full recovery would follow as later stages of successional communities overtake the pioneering species (Rhodes and Germano, 1982). The time it takes to reach a climax community may vary depending on the species and degree of impact. Full benthic community recovery may take years to decades if the benthic habitat is heavily oiled (Gómez Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982).

One must be careful, however, in studying the impacts of the DWH event. One should not immediately designate benthic communities that contain pioneering species as areas that were defaunated as a result of the DWH event. Benthic populations in the Gulf of Mexico that experience yearly hypoxic events are perpetually in early successional stages (Gaston et al., 1998; Diaz and Solow, 1999). These communities are dominated by small, opportunistic, surface-feeding polychaetes, and there is a lack of large, suspension-feeding bivalves (Gaston et al., 1998; Rabalais et al., 2002).

However, one may be able to presume that the early successional stage of a large area of the northern Gulf of Mexico reveals its ability to quickly recover from stressful events, such as yearly hypoxia in areas, and therefore suggests that the benthic community may also rapidly return to its prior state if it was impacted by oil. Recovery after hypoxic events has been reported to begin within 6 months, and full recovery to the original community state has been seen in 1-2 years, depending on other environmental disturbances (Diaz and Solow, 1999; Harper et al., 1991). Similar recovery times would be expected for most communities exposed to sedimented oil unless the area is heavily oiled and, therefore, recovery could take much longer (Gómez Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982).

The areas that may be defaunated as a result of the DWH event are small compared with the area of the entire seafloor of the Gulf of Mexico. The greatest damage is anticipated to have occurred closest to the well where hydrocarbon readings were highest. Much of the seafloor likely did not experience any impact from the event. In areas where low levels of oil reached the seafloor, sublethal or immeasurable impacts may occur. Due to the distance of the well from the WPA (and that the resultant plume and sheen remained east of the WPA boundary), it is unlikely that any soft-bottom communities in the WPA were impacted by the spill.

Sublethal Impacts

Research on oil spilled from the Chevron Main Pass Block 41C Platform into the Gulf of Mexico has indicated that oil in bottom sediments can weather rapidly, leaving only a small percentage of the oil in the sediments after a year (McAuliffe et al., 1975). Substantial weathering was noted 1 week and 1 month after the Chevron Main Pass spill, and the oil remained in the top 1.5 in (3.8 cm) of the sediment. Benthic community fluctuations could not be correlated to the oil in the sediment from this oil spill, and the numbers of brown and white shrimp and blue crabs in the area of the oil spill did not appear to decrease 3 months or 1 year after the spill (McAuliffe et al., 1975). Although the volume of the Chevron Main Pass spill was much less than the volume from the DWH event, it is probable that oil on the seafloor would behave the same way and weather similarly.

The *Ixtoc* oil spill in the Bay of Campeche, Gulf of Mexico, was much more on scale with the volume of oil as a result of the DWH spill that entered the Gulf of Mexico. The *Ixtoc* blowout flowed for 290 days and resulted in an estimated 120,000 metric tons of oil reaching the seafloor (Jernelöv and Lindén, 1981). Oil reached the seafloor in small droplets in the offshore waters, although some aggregates formed nearshore. The approximate concentration of oil on the seafloor was $1 g/m^2$, which is not high enough to cause substantial damage to a benthic ecosystem (Jernelöv and Lindén, 1981). Surface sediment samples collected mid- and post-spill did not reveal any hydrocarbons from the *Ixtoc* spill; however, hydrocarbons from this source were identified on suspended sediment in the water column (ERCO, 1982). This data show that the oil may take some time to reach the seafloor and when it does, it is widely dispersed. This situation could vary, however, depending on the characteristics of the oil and whether or not dispersants are used.

As with the Chevron Main Pass spill, depressions in the benthic community during and following the *Ixtoc* spill could not be linked to the oil because hydrocarbons from the blowout were not present in sediment samples (ERCO, 1982). The benthic populations were depressed following the spill compared with pre-spill conditions; however, environmental evidence was not strong enough to separate oil impacts from natural variation or possible storm damage impacts (Tunnell et al., 1981). Oil may have been present in the sediment and affected benthic communities, but weathered before sampling occurred, or oil in the water column may have affected species, but these possible factors were not measured (Rabalais, 1990).

Regardless of the speculations, field measurements indicate that the concentrations of oil that reached the seafloor were low even after uncontrolled flow for a long period of time, and the oil was vastly dispersed by the time it reached the seafloor. The inability to measure hydrocarbons in the sediment after the spill suggested that any oil that reached the seafloor had weathered rapidly. It is anticipated that similar dispersion of oil, rapid weathering, and resultant low-level, widespread concentrations of oil on the seafloor will be measured from the DWH event.

Long-Term Impacts

Long-term or low-level exposure may also occur to benthic infauna as a result of oil adhering to sediment. Mesocosm experiments using long-term, low-level concentrations of No. 2 fuel oil indicate acute toxicity to meiofauna due to direct oil contact and sublethal effects from sedimented oil and byproducts of the decomposition of the sedimented oil (Frithsen et al., 1985). Long-term exposure to low levels of fuel oil was shown to affect recruitment success; meiofaunal population recovery took between 2 and 7 months (Frithsen et al., 1985). These types of impacts would be expected farther from the well where oil concentrations were diluted with distance.

An increase in contamination levels in sediments can result in a decrease in trophic diversity and an increase in opportunistic pollution tolerant species (Gaston et al., 1998). Contaminated and disturbed areas are generally dominated by small, subsurface deposit feeders (Gaston et al., 1998). These small opportunistic species live at the sediment water interface and are more tolerant of contaminants (Gaston et al., 1998). Those species that can tolerate the disturbed or contaminated environment and recruit rapidly would be the initial colonizers of the area. Two pioneering Capitellid polychaetes in the Gulf of Mexico known to tolerate environmental stress are *Mediomastus californiensis* and *Notomastus latericeus*, and they can be expected in recovering areas (Gaston et al., 1998). Amphipods on the other hand, especially of the genus *Ampelisca*, are extremely sensitive to oil pollution and would not be found in the early recovery stages after hydrocarbon pollution (Gómez Gesteira and Dauvin, 2000). The pioneering community would remain until later successional organisms settle, or the pioneering stage may remain in continually disturbed areas, such as those affected by yearly hypoxia.

An alteration in the benthic trophic structure may impact food availability for fish and invertebrates. Burrowing polychaetes and subsurface deposit feeders are not important in the diets of the red drum and spotted sea trout, two commercially and recreationally important species in the Gulf of Mexico (Gaston et al., 1998). Therefore, an increase in opportunistic species would result in less available food for certain species of fish (Gaston et al., 1998). The small surface-dwelling opportunistic species, however, appear to be important in the diet of juvenile brown shrimp (McTigue and Zimmerman, 1998) and therefore may provide additional food sources for this species. Early stage successional communities, however, cannot store and regulate the nutritional energy that a later stage community can because the organisms are small and remain at the sediment surface, resulting in a less stable and productive food source for higher trophic levels (Diaz and Solow, 1999). Although it is highly unlikely that oil reached the WPA, low-level exposure (to the extent it might have occurred) could result in slightly altered benthic communities with opportunistic species. Recolonization and immigration for successive communities would likely then either supplant or supplement these opportunistic species.

Studies to Measure the Impact of the *Deepwater Horizon* Event

Many studies have been planned to analyze the impact of the DWH event, and some have already been carried out. However, the long-lasting impacts of this event will take years to determine. As more studies are conducted and more data are released, we will have a better understanding of the breadth of the effects of the DWH event. The following description outlines a study that was conducted on the soft-bottom benthic community, primarily surrounding the Flower Garden Banks in the WPA.

The NOAA R/V *Thomas Jefferson* conducted a 13-day mission on June 15-27, 2010, to collect baseline data in portions of the Gulf of Mexico. The cruise collected water and benthic samples and monitored benthic transects to determine baseline conditions at the Flower Garden Banks National Marine Sanctuary prior to any possible impacts as a result of the oil spill as part of its mission (USDOC, NOAA, 2010l). Also, NOAA is currently monitoring for hydrocarbon substances using semipermeable membrane devices that have been placed in the National Marine Sanctuary to determine if oil reaches any of the banks (USDOC, NOAA, 2010g).

The limited data currently available on the impacts of the DWH event make it difficult to definitively describe any impacts that have occurred or may occur to the benthic communities in the WPA. This information will likely be developed through the NRDA process. It may be years before this information becomes available, and certainly not within the timeframe of this Supplemental EIS process. Although this information may be relevant to reasonably foreseeable adverse effects on soft bottoms in the WPA, this information remains incomplete or unavailable at this time, regardless of the costs that would otherwise be necessary to obtain this information. What credible scientific information is available was applied using accepted methodologies. Regardless, complete data are not essential to a reasoned choice among alternatives because of the distance of the WPA from the most western extent of the sheen and plume from the Macondo well (making any impacts extremely remote) and the fact that, even if there were impacts, soft bottoms and their associated species regenerate quickly. Once more data are released, we will obtain a better understanding of the measured impacts and possible long-term effects of this event.

4.1.1.19.1.2. Impacts of Routine Events

The vast majority of the Gulf of Mexico seabed is comprised of soft sediments. These soft-bottom benthic communities of the WPA are described in **Chapter 4.1.1.19.1.1.** Impacts from routine oil and gas activities to the soft-bottom benthic communities are discussed in this section, as a majority of the oil and gas exploration would be conducted in soft seafloor sediments. This is an entirely new section, as soft-bottom benthic community impacts were not discussed in the Multisale EIS or the 2009-2012 Supplemental EIS. Impacts to these communities include infrastructure emplacement, turbidity and smothering, drilling-effluent and produced-water discharges, and infrastructure removal. Disturbances of soft-bottom communities may cause localized disruptions to food sources for some large invertebrate and finfish species.

It is important to note that the effects of routine events on soft-bottom benthos would only impact a very small portion of the 115,645 km^2 (44,651 mi^2) of seafloor in the WPA. Impacts from the drilling of wells are generally confined to a few hundred meters from the well and impacts decrease with distance from the well. Recovery from construction impacts should begin within a year but may take several years to complete recovery (Rhodes and Germano, 1982; Neff et al., 2000; Newell et al., 1998). Recovery would depend on the benthic community composition, sediment type, and the intensity of the disturbance. Long-term operational impacts are localized and generally result in a shift in benthic community dominance (Montagna and Harper, 1996).

Construction Impacts on Infauna and Soft-Bottom Benthic Communities

Organisms from the bacterial level up through polychaete worms and crabs inhabit the soft-bottom benthos. Many of these organisms form the base of the food chain for larger invertebrates and finfish species. Any immobile benthic organisms that are in the footprint of the infrastructure or pipeline emplacement would be physically crushed. The soft-bottom habitat would be replaced with a hard substrate for the life of the structure; for some, such as pipelines or seafloor templates that are abandoned in place at the end of their service, the substitution of hard bottom is permanent. While the substrate and community are changed, the change is generally considered an improvement in value and ecological services. This hard substrate would supply a foundation upon which encrusting organisms may settle (Gallaway and Lewbel, 1982). Encrusting organisms may include barnacles, oysters, mussels, bryozoans, hydroids, sponges, octocorals, corals, and algae (Gallaway and Lewbel, 1982). These organisms provide habitat and food for larger benthic organisms and finfish. The addition of a petroleum platform would result in a community shift from a soft-bottom infaunal community to a reef community above a soft-bottom benthic community. This shift provides more complex habitat, supporting more diverse assemblages than typical soft bottom. The shrimp trawling fishery is negatively affected to a small degree because structures create more obstacles to their trawling. There is also a reduction in trawlable area but this amount is so small compared with the available area (115,645 km^2; 44,651 mi^2) as to be insignificant.

The drilling of a well may result in water column turbidity, smothering of benthic organisms by the deposition of cuttings, coarsening of sediment near the well, trace metal contamination from cuttings, organic enrichment of the seabed, and hypoxic conditions if synthetic-based drilling fluid is used, and possible hydrocarbon contamination. Turbidity is a short-term impact as the cuttings rapidly sink to the seafloor. Burial of benthic communities and alteration of the sediment near the platform would result in the repopulation of smothered benthic habitats, possibly with different species that are adapted to coarser sediment. The impacts of long-term exposures to metals and hydrocarbons in the cuttings are discussed in the following section, as they occur during the lifetime of the project.

Drilling disposal methodology (surface disposal or bottom shunting) and drilling fluid (synthetic or water based) would result in slight differences in the dispersal of the well cuttings and drilling muds. For example, well cuttings that are disposed of at the water's surface tend to disperse in the water column and are distributed widely at low concentrations (CSA, 2004b; NRC, 1983). In deep water, cuttings discharged at the sea surface may spread out to 1,000 m (3,280 ft) from the source, depending on currents, with the thickest layers at the well and the majority of the sediment within 250 m (820 ft) (CSA, 2006a).

On the other hand, cuttings that are shunted to the seafloor are concentrated over a smaller area in piles instead of being physically dispersed over wide areas (Neff, 2005). The heaviest concentrations of well cuttings and drilling fluids, for both water-based and synthetic-based drilling muds, have been reported within 100 m (328 ft) of well and are shown to decrease beyond that distance (CSA, 2004b; Kennicutt et al., 1996). Deposition may reach up to 500 m (1640 ft) from the well, depending on surrounding environmental conditions (Kennicutt et al., 1996).

Surface-released cuttings rarely accumulate thicknesses of about 1 m (3 ft) immediately adjacent to the well; thicknesses are usually not higher than a few tens of centimeters (about 1 ft) in the GOM. A gradient of cuttings that encompasses most of the cuttings settles within 100 m (328 ft) of the well site. Cuttings settle in a patchy distribution determined by water currents and limited to about 250 m (820 ft) from the well site (CSA, 2004b). Impacts would be less in shallow waters than deep waters, as the shallow water organisms have greater vertical migration ability in the sediment than the deepwater benthos (CSA, 2004b). Because cuttings are distributed unevenly and in patches, burial would likely be localized (CSA, 2004b).

The greatest impact to the benthic community may result from the shunting of cuttings to the seafloor in order to protect nearby topographic features. Cuttings that are shunted to the seafloor form concentrated thicker depositions over a smaller area of soft seafloor (Neff, 2005). Any organisms beneath heavy layers of deposited cuttings would be smothered.

Additional stress may occur if synthetic drilling fluids are used. Base fluids of synthetic drilling muds that remain on the cuttings are designed to be low in toxicity and biodegradable in offshore marine sediments (Neff et al., 2000). However, as bacteria and fungi break down the synthetic drilling fluids, the sediments may become anoxic (Neff et al., 2000). Benthic macrofaunal recovery would occur when synthetic drilling mud concentrations are reduced to levels that enable the sediment to become reoxygenated (Neff et al., 2000). Complete community recovery from synthetic drilling mud exposure may take 3-5 years (Neff et al., 2000).

Sediment grain size may be altered near the new structure. Investigations have shown that sediments were enriched with sandy material out to 100 m (328 ft) from a well (Kennicutt et al., 1996). Altered grain size can result in different species inhabiting the sediment.

Recolonization and immigration by organisms from neighboring soft-bottom substrate to the impacted areas would be expected to occur within a relatively short period of time. Initial repopulation from nearby stocks may begin with the following recruitment event and be predominantly comprised of pioneering species, such as tube-dwelling polychaetes or oligochaetes (Rhodes and Germano, 1982). Full recovery would follow as later stages of successional communities overtake the opportunistic species (Rhodes and Germano, 1982), but the time it takes to reach a climax community may vary depending on the species and degree of impact. Initial recovery should be well advanced within a year following the deposition (Neff, 2005). Because some benthic communities in the northern Gulf of Mexico are permanently in early community successional stages due to frequent disturbances, full recovery may occur very quickly (Rabalais et al., 2002; Gaston et al., 1998; Diaz and Solow, 1999).

Long-Term and Operational Impacts on Infauna and Soft-Bottom Benthic Communities

Benthic organisms may experience long-term impacts such as exposure to contaminants, alteration in habitat, and a change in community structure as a result of offshore oil and gas production. These impacts are generally localized and occur close to the production platform (within 100-200 m [328-656 ft] from the platform) (Montagna and Harper, 1996; Kennicutt et al., 1996; Hart et al., 1989; Kennicutt, 1995; CSA, 2004b). Sand content, metals, barium, inorganic carbon, and petroleum products have all been reported to be elevated near platforms (Kennicutt, 1995). Distribution of discharges tends to be patchy, have sharp gradients, and be directional (Kennicutt, 1995). The greatest impacts occur in low-energy environments where depositions may accumulate and not be redistributed (Neff, 2005; Kennicutt et al., 1996). Despite these possible impacts, it is important to consider that they occur over a very small portion of the seafloor of the Gulf of Mexico. The WPA covers 115,645 km^2 (44,651 mi^2) and is mostly soft-bottom sediment.

Long-term impacts of oil and gas production have been studied in the Gulf of Mexico Offshore Monitoring Experiment and other monitoring programs. These programs indicated that the greatest long-term impacts to benthic organisms were from the deposition of drilling muds and cuttings on the seabed.

Drilling mud is primarily composed of barium. Elevated levels of barium, silver, cadmium, mercury, lead, and zinc were found out to 200 m (656 ft) from platforms and are likely a product of drilling mud and cuttings (Kennicutt et al., 1996; Hart et al., 1989; Chapman et al., 1991; CSA, 2004b). The concentrations of metals decreased with distance from the platform and were highest in low-energy environments (Kennicutt et al., 1996).

Other additions of metals to sediments near offshore platforms may come from produced waters and corrosion of the structure itself. Information is contradictory on the distance from a platform that produced waters can affect benthic communities. Impacts have been reported from 100 m (328 ft) of the source to 1 km (0.6 mi) from the source (Peterson et al., 1996; Armstrong et al., 1977; Osenberg et al., 1992). Elevated levels of lead, zinc, and cadmium in sediments near platforms are most likely deposited from produced waters and corrosion of the galvanized platform itself (Kennicutt et al., 1996). Lead concentrations have been reported to continue to accumulate in sediment during the lifetime of an offshore platform (Kennicutt et al., 1996). The continual addition of metals to sediment near platforms results in continuous exposure of benthos to the metals.

Metal concentrations in sediments near gas platforms have been reported above those that may cause deleterious biological effects. Sublethal infaunal impacts have been reported out to 100 m (328 ft) from the platform. Of the species sampled, harpacticoid copepods were most sensitive to contamination. They showed reduced abundances, reduced survival, and an increased but less successful reproductive effort paired with reduced recruitment closer to platforms (Montagna and Harper, 1996; Carr et al., 1996). Copepods showed reduced genetic diversity near platforms and the production efficiency of nematodes was found to be reduced by half within 50-100 m (164-328 ft) of a platform (Montagna and Li, 1997; Kennicutt, 1995). The impacts are believed to be a result of metal toxicity originating from drill cuttings that remain in the sediment during the installation of the well (Montagna and Harper, 1996; Carr et al., 1996).

Lethal impacts may also occur near the wells due to localized elevated metal concentrations in sediments from cuttings. Porewater toxicity as a result of metal contamination was detected near gas platforms (Carr et al., 1996). Sea urchin fertilization and embryological development were reduced within 150 m (492 ft) from gas platforms, as was polychaete reproduction and copepod nauplii survival (Carr et al., 1996; Kennicutt, 1995).

Hydrocarbon contamination as a result of regular gas production activities is relatively low (Montagna and Harper, 1996). Hydrocarbon enrichment has been reported within 25 m (82 ft) and out to 200 m (656 ft) of petroleum platforms, and the concentrations decreased with distance from the platforms (Hart et al., 1989; Chapman et al., 1991; Kennicutt, 1995; Kennicutt et al., 1996). The concentrations of PAH's in the sediment surrounding platforms, however, were below the biological thresholds for marine organisms and appeared to have little effect on benthic organisms (Hart et al., 1989; McDonald et al., 1996; Kennicutt et al., 1996). Other studies indicated that chronic low-level discharges from petroleum production in the northern Gulf of Mexico did not result in hydrocarbons accumulating to stressful levels in benthic organisms or resultant organism responses to the hydrocarbons (Sharp and Appan, 1982).

It is anticipated that hydrocarbon contamination at oil-producing wells is higher than for gas wells (Carr et al., 1996). Unlike with metals, links between petroleum products and benthic impacts are not established (Holdway, 2002; Southwest Research Institute, 1981). It is possible that petroleum hydrocarbons in drilling muds and cuttings may cause toxicity to benthic organisms and bioaccumulate up the food chain; however, very little information is available on such impacts (Neff, 2005). It is also possible that continuous influx of contaminants from the Mississippi River and periodic flooding and storms mask the impact to benthic organisms from chronic exposure to petroleum production (Southwest Research Institute, 1981). Variation in natural environments also makes it difficult to determine a link between petroleum production impacts and natural environmental impacts on benthic communities (Holdway, 2002). Although concrete information on the link of hydrocarbon contamination and benthic impacts would be relevant, it is not essential to a reasoned choice among alternatives. As described below, there is scientifically credible information, applied below, regarding what the potential impacts to benthic communities may be from hydrocarbons and related contaminants.

The sedimentary environment surrounding a well may be altered by the disposal of cuttings on the seafloor. The sediment grain size near petroleum platforms was reportedly larger and enriched with sand compared with the surrounding environment (Kennicutt et al., 1996). Sediment was coarser within 100 m (328 ft) of a discharge site and sediment alterations have been reported out to 500 m (1,640 ft), depending on the surrounding environment and method of disposal (surface disposal or bottom shunting) (CSA, 2004b; Kennicutt et al., 1996). Sediment was coarser near the platform, becoming finer with distance (Hart et al., 1989; Kennicutt, 1995). The field of impact is not heterogeneous and there are often concentration gradients within the discharged material, which is often deposited directionally as it is carried by water currents (Kennicutt, 1995).

Metal and hydrocarbon concentrations and altered sediment characteristics near wells may result in an altered benthic population surrounding the production platform. Significant impacts to benthos as a result of sediment alteration were measured within a few hundred meters of petroleum platforms (Kennicutt, 1995). The benthic assemblages within 150 m (492 ft) of some wells differed from the infaunal deposit-feeding species farther from the well (Hart et al., 1989). Epifaunal organisms can be sloughed from the platform to the surrounding seafloor, and the bottom community surrounding the platform may be similar to those associated with shell reefs, rubble bottoms, and hard substrates (Hart et al., 1989). The infaunal deposit-feeding species that are typical of the Gulf of Mexico seafloor become more prevalent with distance from the well.

Contaminants also reportedly altered benthic community structure in a 25- to 100-m (82- to 328-ft) radius surrounding platforms (Chapman et al., 1991; Montagna and Harper, 1996). In general, polychaetes, bivalves, nemerteans, decapods, and isopods all increased near platforms, while amphipods and foraminiferans, which are more sensitive to contamination, decreased near platforms and increased with distance from the well (Chapman et al., 1991; Montagna and Harper, 1996; Kennicutt, 1995). Deposit feeders are generally much less sensitive to environmental contaminants than the crustaceans, and reduced crustacean populations are likely the result of elevated metal concentrations near platforms resulting from well drilling, produced waters, and corrosion of the structure (Peterson et al., 1996).

Mobile epifaunal organisms do not show trends associated with distance from platforms. Instead, each platform is a unique community that is influenced by the physical and chemical parameters of the platform itself (Ellis et al., 1996). The platforms, however, act as artificial reefs, attracting encrusting organisms to the introduced structure. The colonization of platforms and resultant attraction of fish and mobile invertebrates may result in localized organic enrichment in sediments near the platforms (Montagna and Harper, 1996). Organic enrichment has been reported within 100 m (328 ft) of wells and may alter benthic communities where sediment is enriched (CSA, 2004b). Enriched sediments may lead to increased infaunal deposit-feeder density and diversity near platforms as reported by Montagna and Harper (1996). The number of organisms was reportedly greater within 100 m (328 ft) of platforms, most likely due to the organic enrichment near platforms (Kennicutt, 1995). Surveys indicate that, although the number of organisms was high within this radius, species diversity was low and dominated by a few opportunistic species (CSA, 2004b). Elevated, nonselective, deposit-feeding populations near platforms are likely the combined result of enriched organic material near the platforms as a result of "organic shedding" from platforms and opportunistic species populating defaunated sediment as a result of metal toxicity or anaerobic conditions (Peterson et al., 1996; Kennicutt, 1995; CSA, 2004b). Deposit feeders are able to utilize organic material in polluted areas as a food source, allowing them to feed in areas other organisms cannot tolerate (Peterson et al., 1996). Bivalves may also be found in organically enriched areas, as many bivalves are able to tolerate low dissolved oxygen levels that can occur in such environments (CSA, 2004b).

Synthetic drilling fluids are designed to be nontoxic to marine organisms; however, as bacteria and fungi break down the synthetic drilling fluids, the sediments may become anoxic (Neff et al., 2000). The time it takes for the sediment to hold enough oxygen for organisms to populate the area may take several years (Neff et al., 2000). The time between drilling and repopulation may result in an altered benthic community. Monitoring of a drill site indicated that sediments out to 75 m (246 ft) from the site were anaerobic 4 months after drilling and benthic infauna abundance was low out to 200 m (656 ft) (CSA, 2004b). The opportunistic polychaete, *Capitella capitata*, was abundant out to 125 m (410 ft) from the drill site but was not found beyond 200 m (656 ft) from the well (CSA, 2004b). Evidence of recovery was observed a year after drilling occurred, especially at stations greater than 75 m (246 ft) from the well (CSA, 2004b). After 2 years, community structure had recovered, but species composition was slightly altered (CSA, 2004b). Biological effects appear to be a result of the organic enrichment from synthetic-based drilling fluid, and the resultant biodegradation and anaerobic conditions (CSA, 2004b).

It should be noted that the combined impacts of drilling wells may lead to unexpected ecological interactions surrounding wells. For example, infaunal deposit feeders are usually associated with finer sediments, but they are seen in the coarser sediments close to platforms. This is probably due to both tolerance to contaminants in the sediment and their ability to utilize organic enrichment in the sediment deposited by higher tropic levels or from the breakdown of synthetic drilling fluids. Epifaunal organisms, however, are those that associate with coarser sediments and reefs, as there is substrate on the reef and larger material in the sediment for attachment. These alterations lead to a local altered environment that is specific to each platform and its impacts on the surrounding environment (Montagna and Harper, 1996; Hart et al., 1989; Ellis et al., 1996).

An alteration in the benthic community may impact food availability for fish and invertebrates. Burrowing polychaetes and subsurface deposit feeders are not important in the diets of the red drum and spotted sea trout, two commercially and recreationally important species in the Gulf of Mexico (Gaston et al., 1998). Therefore, an increase in opportunistic species would result in less available food for certain species of fish (Gaston et al., 1998). The small surface-dwelling opportunistic species, however, appear to be important in the diet of juvenile brown shrimp (McTigue and Zimmerman, 1998) and therefore may provide additional food sources for this species. Early stage successional communities, however, cannot store and regulate the nutritional energy that a later stage community can because the organisms are small and remain at the sediment surface, resulting in a less stable and productive food source for higher trophic levels (Diaz and Solow, 1999). This impact on higher trophic levels may last as long as the alteration in benthic community structure does.

Structure-Removal Impacts

The impacts of structure removal on soft-bottom benthic communities can include turbidity, sediment deposition, explosive shock-wave impacts, and loss of habitat. Both explosive and nonexplosive removal operations would disturb the seafloor by generating considerable turbidity. Suspended sediment may evoke physiological impacts in benthic organisms including “changes in respiration rate, . . . abrasion and puncturing of structures, reduced feeding, reduced water filtration rates, smothering, delayed or reduced hatching of eggs, reduced larval growth or development, abnormal larval development, or reduced response to physical stimulus” (Anchor Environmental CA, L.P., 2003). The higher the concentration of suspended sediment in the water column and the longer the sediment remains suspended, the greater the impact. Also, different species have differing tolerances to suspended sediment. In general, polychaete worms can withstand much higher concentrations of suspended sediment in the water column than amphipods (Swanson et al., 2003). Bivalves can withstand high concentrations of suspended sediment by reducing net pumping rates and rejecting material in pseudofeces (Clarke and Wilber, 2000). Mobile organisms have a much better chance of escaping high suspended sediment concentrations and the possible resultant smothering than sessile organisms do because they can avoid areas of disturbance (Clarke and Wilber, 2000).

Structural removal may also result in resuspension of contaminated sediments (Schroeder and Love, 2004). The impact to benthic organisms as a result of contaminant exposure from suspended sediments is dependent on many variables and not well understood (Eggleton and Thomas, 2004). Acute toxicity, chronic impacts, and bioavailability would all be dependent on the changes in the physical and chemical environment as a result of the disturbance.

Sediment deposition may smother benthic organisms, decreasing gas exchange, increasing exposure to anaerobic sediment, reducing light intensity, and causing physical abrasion (Wilber et al., 2005). Many benthic organisms have the ability to tolerate some sedimentation, as they experience it through natural processes (Wilber et al., 2005). For example, organisms may vertically migrate up through deposited sediment (Wilber et al., 2005). If a different size sediment is deposited on the seafloor than what is presently there, the impacts may be greater than if the same grain size was deposited, and the habitat may be altered as a result (Wilber et al., 2005).

The shock waves produced by explosive structure removals damage some benthic organisms in the near vicinity of the blasts. O’Keeffe and Young (1984) described the impacts of underwater explosions on various forms of sea life using, for the most part, open-water explosions much larger than those used in typical structure-removal operations. They found that sessile benthic organisms, such as barnacles and oysters, and many motile forms of life, such as shrimp and crabs, that do not possess swim bladders were remarkably resistant to shock waves generated by underwater explosions. Oysters located 8 m (26 ft) away from the detonation of 135-kg (298-lb) charges in open water incurred a 5 percent mortality rate.

Crabs distanced 8 m (26 ft) away from the explosion of 14-kg (31-lb) charges in open water had a 90 percent mortality rate. Few crabs died when the charges were detonated 46 m (151 ft) away. O'Keeffe and Young (1984) also noted ". . . no damage to other invertebrates such as sea anemones, polychaete worms, isopods, and amphipods." Impacts to invertebrates are anticipated to be minimal as they do not have air bladders inside their bodies that may burst with explosions as some fish do (Schroeder and Love, 2004).

Benthic organisms appear to be further protected from the impacts of subbottom explosive detonations by rapid attenuations of the underwater shock wave traversing the seabed away from the structure being removed. The shock wave is significantly attenuated when explosives are buried as opposed to detonation in the water column (Baxter et al., 1982). Theoretical predictions suggest that the shock waves of explosives set 5 m (15 ft) below the seabed, as required by BOEMRE regulations, would attenuate blast effects (Wright and Hopky, 1998).

Infrastructure or pipeline removal would impact both the communities that have colonized the structures and the soft-bottom benthos surrounding the structure. Removal of the structure itself would result in the removal of the hard substrate and encrusting community. The overall community would experience a reduction in species diversity (both epifaunal encrusting organisms and the fish and large invertebrates that fed on them) with the removal of the structure (Schroeder and Love, 2004). The epifaunal organisms attached to the platform that are physically removed would die once the platform is removed. However, the seafloor habitat would return to the original soft-bottom substrate that existed before the well was drilled.

Some structures may be converted to artificial reefs. If the platform stays in place, the hard substrate and encrusting communities would remain part of the benthic habitat. The diversity of the community would not change and associated finfish species would continue to graze on the encrusting organisms. The community would remain an active artificial reef. However, the plugging of wells and other reef in place decommissioning activities would still impact benthic communities as discussed above, since all the steps for removal except final removal from the water would still occur.

Proposed Action Analysis

As mentioned earlier, a majority of the seafloor of the Gulf of Mexico is soft-bottom sediments. Drilling activities would occur directly in these soft substrates; however, these routine activities would only affect a small portion of the substrate and benthic communities of the Gulf of Mexico. The WPA covers 115,645 km^2 (44,651 mi^2). Operations may affect soft-bottom benthic communities through drilling effluent discharges and produced-water discharges, blowouts, and oil spills. Of the small area affected, the impacts have been measured to reach only about 100- 500 m (328-1,640 ft) from the production well.

For the WPA proposed action, 40-66 exploration/delineation and 137-221 development wells are projected **(Table 3-2)**. Cuttings from the wells would be released at the sea surface and dispersed in the water column, resulting in a widespread deposition on the seafloor (up to 1,000 m [3,280 ft] distance; CSA, 2006a). Deposition thickness would be patchy, but it should only accumulate a few centimeters to possibly a meter on the seafloor (beside the well) (CSA, 2004b and 2006a). Benthic organisms are anticipated to either vertically migrate through the depositional layers or immigrants would repopulate the smothered habitat. Altered community structure may occur as a result of the environmental changes, but this alteration would be limited to a few hundred meters from the well.

If any of these wells are proposed near a topographic feature, no discharges would take place within the feature's No Activity Zone. The drilling discharges would be shunted to within 10 m (33 ft) of the seafloor either within the 1,000-Meter Zone, 1-Mile Zone, 3-Mile Zone, or 4-Mile Zone (depending on the topographic feature) around the No Activity Zone (see **Chapter 2.3.1.3.1** for specifics). This procedure would essentially prevent the threat of large amounts of drilling effluents reaching the biota of a given topographic feature. It would, however, result in heavy layers of cuttings on the seafloor, which could smother underlying benthic communities and create turbid waters in a localized area near the well. Seafloor depositions have been measured to 1,000 m (3,280 ft) in a gradient of declining density with distance from the well (Kennicutt et al., 1996; CSA, 2006a). Benthic organisms may not be able to vertically migrate through the heavy depositional layers near the well, but it is anticipated that they would repopulate the areas through the reproduction and immigration of nearby stocks. Altered community structure may occur as a result of environmental changes, but this alteration would be limited to a few hundred meters from the well.

For the WPA proposed action, 26-41 production structures are projected. Between 14 and 25 structure removals using explosives are projected (**Table 3-2**). The explosive removals of platforms may impact the biota through suspended sediment, sediment redeposition and smothering, explosive shock, and loss of hard substrate habitat. Communities, however, are anticipated to recover. Turbidity impacts would be short lived, and many organisms are tolerant of short-term increases in turbidity. Repopulation of the area disturbed by burial and shock-wave effects would begin within 6 months to a year, although it may take several years for complete recovery (Rhodes and Germano, 1982; Neff et al., 2000; Newell et al., 1998). And although the hard substrate that provided structure for encrusting organisms that created an artificial reef habitat may be removed, the environment would return to its previous state as a soft-bottom infaunal community.

Summary and Conclusion

Although localized impacts to comparatively small areas of the soft-bottom benthic habitats would occur, the impacts would be on a relatively small area of the seafloor compared with the overall area of the seafloor of the WPA (115,645 km^2, 44,651 mi^2). The greatest impact is the alteration of benthic communities as a result of smothering, chemical toxicity, and substrate change. Communities that are smothered by cuttings repopulate, and populations that are eliminated as a result of sediment toxicity or organic enrichment would be taken over by more tolerant species. The community alterations are not so much the introduction of a new benthic community as a shift in species dominance (Montagna and Harper, 1996). These localized impacts generally occur within a few hundred meters of platforms, and the greatest impacts are seen close to the platform. These patchy habitats within the Gulf of Mexico are probably not very different from the early successional communities that predominate throughout areas of the Gulf of Mexico that are frequently disturbed (Rabalais et al., 2002; Gaston et al., 1998; Diaz and Solow, 1999).

4.1.1.19.1.3. Impacts of Accidental Events

The majority of the seafloor of the Gulf of Mexico is comprised of soft substrate. The soft-bottom benthic communities of the WPA are described in **Chapter 4.1.1.19.1.1.** Any activity that may affect the soft-bottom communities would only impact a small portion of the overall area of the seafloor of the Gulf of Mexico. Because the soft-bottom substrate is ubiquitous throughout the Gulf of Mexico, there are no lease stipulations to avoid these communities. Other routine practices restrict detrimental activities that could cause undue harm to benthic habitats (e.g., discharge restrictions, debris regulations, NPDES permits).

Although a low-probability catastrophic spill is not expected, the types or kinds of impacts to soft-bottom communities would likely be the same for a catastrophic or a more typical smaller scale accidental event. As such, the analysis below addresses both types of spills, in addition to the general analysis for catastrophic events in **Appendix B**.

Possible Modes of Exposure

Oil released to the environment as a result of an accidental event may impact soft-bottom benthic communities in several ways. Oil may be physically mixed into the water column from the sea surface, injected below the sea surface and travel with currents, dispersed in the water column, or sedimented to particles and sink to the seafloor. These scenarios and their possible impacts are discussed in the following sections.

An oil spill that occurs at the sea surface would result in a majority of the oil remaining at the sea surface. Lighter compounds in the oil may evaporate and some components of the oil may dissolve in the seawater. Evaporation allows the removal of the most toxic components of the oil, while dissolution may allow bioavailability of hydrocarbons to marine organisms for a brief period of time (Lewis and Aurand, 1997). Remnants of the oil may then emulsify with water or sediment to particles and fall to the seafloor.

A spill that occurs below the sea surface (at the rig, along the riser between the seafloor and sea surface, or through leak paths on the BOP/wellhead) would result in most of the released oil rising to the sea surface. All known reserves in the Gulf of Mexico have specific gravity characteristics that would preclude oil from sinking immediately after release at a blowout site. As discussed in Chapter 4.3.1.5.4 of the Multisale EIS, oil discharges that occur at the seafloor from a pipeline or loss of well control would rise in the water column, surfacing almost directly over the source location, thus not impacting sensitive deepwater communities. If the leak is deep in the water column and the oil is ejected under pressure, oil droplets may become entrained deep in the water column (Boehm and Fiest, 1982). The upward movement of the oil may be reduced if methane in the oil is dissolved at the high underwater pressures, reducing the oil's buoyancy (Adcroft et al., 2010). The large oil droplets would rise to the sea surface, but the smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010). Oil droplets less than 100 μm (0.004 in) in diameter may remain in the water column for several months (Joint Analysis Group, 2010a). Dispersed oil in the water column begins to biodegrade and may flocculate with particulate matter, promoting sinking of the particles.

Impacts that may occur to soft-bottom benthic communities as a result of a spill would depend on the type of spill, distance from the spill, and surrounding physical characteristics of the environment. As described above, most of the oil released from a spill would rise to the sea surface, therefore, reducing the impact to benthic communities by direct oil exposure. However, small droplets of oil that are entrained in the water column for extended periods of time would migrate within the water column. Although these small oil droplets would not sink themselves, they may attach to suspended particles in the water column and then be deposited on the seafloor (McAuliffe et al., 1975). Exposure to subsea plumes, dispersed oil, or sedimented oil may result in impacts such as smothering, reduced recruitment success, reduced growth, toxicity to larvae, alteration of embryonic development, and altered community structure. These impacts are discussed in the following sections.

Surface Slick and Physical Mixing

Surface oil slicks can spread over a large area; however, the majority of the slick is comprised of a very thin surface layer of oil moved by winds and currents (Lewis and Aurand, 1997). The potential of surface oil slicks to affect benthic habitats is limited by its ability to mix into the water column. Soft-bottom benthic communities below 10-m (33-ft) water depth are protected from surface oil because of its lack of ability to mix with water (Lange, 1985; McAuliffe et al., 1975 and 1981a; Tkalich and Chan, 2002). Benthic organisms would not become physically coated or smothered by surface oil. However, if this surface oil makes its way into the water column through physical mixing, the use of dispersants, or sedimenting to particles in the water column, benthic communities may be impacted. These scenarios are discussed in later sections.

Disturbance of the sea surface by storms can mix surface oil into the water column, but the effects are generally limited to the upper 10 m (33 ft). Modeling exercises have indicated that oil may reach a depth of 20 m (66 ft). Yet at this depth, the spilled oil would be at concentrations several orders of magnitude lower than the amount shown to have an effect on marine organisms (Lange, 1985; McAuliffe et al., 1975 and 1981a; Tkalich and Chan, 2002). Therefore, soft-bottom benthic communities located in shallow water have the potential to be fouled by oil that is floating on shallow water and mixes to the depth of the seafloor. Nearshore oil deposits that occur in sheltered areas, such as bays, may remain in the sediment and impact organisms for long periods. Oil in nearshore sediments was found in high concentrations 8 years following the *Exxon Valdez* spill (Dean and Jewett, 2001). Benthic communities located in deeper water would not be impacted by oil physically mixed into the water column. However, if dispersants are used, they would enable oil to mix into the water column and possibly impact organisms in deeper water. Dispersants are discussed later in this section.

Subsurface Plumes

A subsurface oil spill or plume has the potential to reach a soft-bottom benthic community and cause negative effects. Such impacts on the biota may have severe and long-lasting consequences, including loss of habitat and biodiversity; change in community structure; toxicity to larvae and embryos; and failed reproductive success.

A subsurface plume that contacts the seafloor may result in acute toxicity. The water accommodated fraction (WAF) or water soluble fraction (WSF) of oil that dissolves in water may be the most toxic to organisms, especially larvae and embryos in the water column or at the water sediment interface. Lethal effects for marine invertebrates have been reported at exposures between 0.10 ppm to 100 ppm WSF of oil (Suchanek, 1993). The WSF of petroleum hydrocarbons was reportedly highly toxic to the embryos of oysters and sea urchins, while sediment containing weathered fuel was not toxic to the same species (Beiras and Saco-Álvarez, 2006). Quahog clam embryos and larvae also experienced toxicity and deformation of several different crude oils at WSF concentrations between 0.10 ppm and 10 ppm (Byrne and Calder, 1977). An experiment indicated that the WSF of No. 2 fuel oil at a concentration of 5 ppm disrupted the cellular development of 270 out of 300 test organisms within 3 hours of exposure (Byrne, 1989). After 48 hours exposure, all of the test organisms died and the 48-hour LC_{50} (lethal concentration for 50 percent of the test population) was calculated to be 0.59 ppm (Byrne, 1989). Another experiment indicated that a WSF of 0.6 ppm and greater of No. 2 fuel oil depressed respiration, reduced mobility of sperm, interfered with cell fertilization and embryonic cleavage, and retarded larval development of sand dollar eggs (Nicol et al., 1977). Experiments that exposed sea urchin embryos to 10-30 ppm WSF of diesel oil for 15-45 days resulted in defective embryonic development and nonviable offspring (Vashchenko, 1980). Therefore, any dissolved petroleum hydrocarbon constituents that reach larval benthic organisms may cause acute toxicity and other developmental effects to this life stage.

Sublethal responses of marine invertebrates may result in population level changes (Suchanek, 1993). Such sublethal responses may occur at concentrations as low as 1-10 ppb (Hyland and Schneider, 1976). Sublethal impacts may include reduced feeding rates, reduced ability to detect food, ciliary inhibition, reduced movement, decreased aggression, and altered respiration (Suchanek, 1993).

The farther a subsea plume travels, the more physical and biological changes occur to the oil before it reaches benthic organisms. Oil would become diluted as it physically mixes with the surrounding water, and some evaporation may occur from surface slicks. The most toxic compounds of oil are lost within the first 24 hours of a spill, leaving the heavier, less toxic compounds in the system (Ganning et al., 1984). Water currents could carry a plume to contact the seafloor directly but a likely scenario would be for the oil to adhere to other particles and precipitate to the seafloor, much like rainfall (ITOPF, 2007; Kingston et al., 1995). Oil also would reach the seafloor through consumption by plankton with excretion distributed over the seafloor (ITOPF, 2007). The longer and farther a subsea plume travels in the sea, the more dilute the oil would be (Vandermeulen, 1982; Tkalich and Chan, 2002). In addition, microbial degradation of the oil occurs in the water column, reducing toxicity (Hazen et al., 2010; McAuliffe et al., 1981b). The oil would move in the direction of prevailing currents (S.L. Ross Environmental Research Ltd., 1997) and, although the oil would weather with the distance it travels, low levels of oil transported in subsea plumes would impact benthic communities. These mechanisms would result in a wide distribution of small amounts of oil. This oil would be in the process of biodegradation from bacterial action, which would continue on the seafloor, resulting in scattered microhabitats with an enriched carbon environment (Hazen et al., 2010).

Dispersed Oil

Chemically dispersed oil from a surface slick is not anticipated to result in lethal exposures to organisms on the seafloor. The chemical dispersion of oil may increase the weathering process and allow surface oil to penetrate to greater depths than physical mixing would permit, and the dispersed oil generally remains below the water's surface (McAuliffe et al., 1981b; Lewis and Aurand, 1997). However, reports on dispersant usage on surface plumes indicates that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a). Dispersant usage also reduces the oil's ability to stick to particles in the water column, slowing its rate of precipitation to the seafloor (McAuliffe et al., 1981a; Lewis and Aurand, 1997). However, the use of dispersant increases oil concentrations in the water column, ultimately leading to precipitation on the seafloor in some form (Whittle et al., 1982).

Field experiments designed to test dispersant use on oil spills reported dispersed oil concentrations between 1 and 3 ppm, 9 m (30 ft) below the sea surface, approximately 1 hour after treatment with dispersant (McAuliffe et al., 1981a and 1981b). Other studies indicated that dispersed oil concentrations were <1 ppm, 10 m (33 ft) below the sea surface (Lewis and Aurand, 1997). The above data indicate that the mixing depth of dispersed oil is less than the depths of the majority of the Gulf of Mexico. Oil plumes are carried by water currents; some of these currents may carry subsea plumes toward shore, reaching water shallow enough for the plume to impinge on the seafloor. Unless the source of the oil is in shallow water, the dispersed oil would likely be widely diffused by the time it reaches shallow water. Most currents, however, would move laterally along depth contours rather than approaching shore, since the shore acts as a barrier containing the water, much like a levee bounding a river; inshore water would have to be displaced for offshore currents to move shoreward. Therefore, most subsea oil plumes would continue in oceanic currents until the oil is deposited to the seafloor over time by flocculation (clumping), planktonic consumption and excretion, or bacterial biodegradation (eventually bacteria die and fall to the seafloor) (Hazen et al., 2010; ITOPF, 2007; Kingston et al., 1995). This pattern would result in distribution of tiny quantities of oil that are widely scattered over a very large area. This oil would be in the process of biodegradation from bacterial action, which would continue on the seafloor, resulting in scattered microhabitats with an enriched carbon environment (Hazen et al., 2010).

Any dispersed surface oil that may reach the benthic communities in the Gulf of Mexico would be expected to be at very low concentrations (<1 ppm) (McAuliffe et al., 1981a). Such concentrations may not be life threatening to adult stages but may harm larval or embryonic life stages of benthic organisms (Fucik et al., 1995; Suchanek, 1993; Beiras and Saco-Álvarez, 2006; Byrne, 1989). The LC_{50} for blue crab, white shrimp, and brown shrimp exposed to western and central Gulf of Mexico oil dispersed with *Corexit 9527* experienced toxicity of 50 percent of the test population at concentrations an order of magnitude greater than what is expected for dispersed oil in the environment (Fucik et al., 1995). Any dispersed oil in the water column that comes in contact with benthic organisms, however, may evoke short-term negative responses by the organisms or altered embryonic survival and development such as that discussed in the subsurface plumes section.

Dispersants that are used on oil below the sea surface can travel with currents through the water and may contact benthic organisms on the seafloor. It is possible that the dispersed oil could be concentrated enough to harm a benthic community near the oil's source. However, the longer the oil remains suspended in the water column traveling with currents, the more it would disperse. Weathering would also be accelerated and biological toxicity reduced (McAuliffe et al., 1981b). Although the use of subsea dispersants is a new technique and very little data are available on dispersion rates, it is anticipated that any oil that could reach the seafloor would be in low concentration based on surface slick dilution data (McAuliffe et al., 1981a; Lewis and Aurand, 1997). Therefore, impacts resulting from exposure to dispersed oil, except possibly for communities very close to applications, are anticipated to be sublethal.

Soft-bottom infaunal communities near the oil spill that are negatively impacted by direct contact with oil or dispersed oil may experience sublethal and/or lethal effects. Localized areas of lethal effects would be recolonized by populations from neighboring soft-bottom substrate once the oil in the sediment has been sufficiently reduced to support marine life (Sanders et al., 1980). This initial recolonization process may be fairly rapid, but full recovery may take up to 10 years, depending on the species present, substrate in the area, toxicity of oil spilled, concentration and dispersion of oil spilled, and surrounding environmental factors that may also affect recruitment (Kingston et al., 1995; Gómez Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982). Opportunistic species would take advantage of the barren sediment, repopulating impacted areas first. These species may occur within the first recruitment cycle of the surrounding populations or from species immigration from surrounding stocks, and they may maintain a stronghold in the area until community succession proceeds (Rhodes and Germano, 1982; Sanders et al., 1980).

Sedimented Oil (Oil Adsorbed to Sediments)

Smaller suspended oil droplets could be carried to the seafloor as a result of oil droplets adhering to suspended particles in the water column. Smaller particles have a greater affinity for oil (Lewis and Aurand, 1997). Oil may also reach the seafloor through consumption by plankton with excretion distributed over the seafloor (ITOPF, 2007). Oiled sediment that settles to the seafloor may affect benthic organisms. It is anticipated that the greatest amount of sedimented oil would occur close to the spill, with lesser concentrations farther from the source. Studies after a spill that occurred at the Chevron Main Pass Block 41C Platform in the northern Gulf of Mexico revealed that the highest concentrations of oil in the sediment were close to the platform and that the oil settled to the seafloor within 5-10 mi (8-16 km) of the spill site (McAuliffe et al., 1975). Therefore, the benthic communities closest to the source of a spill may become smothered by the particles and exposed to toxic hydrocarbons.

Oiled sediment depositional impacts, however, are possible as a result of an oil spill and may smother nearby benthic species. Organisms that are physically smothered by sedimented oil, or the oil itself, may experience reduced respiration and inhibition of movement, and mobile organisms may experience additional weight or shearing forces from the sedimented oil (Suchanek, 1993). Barnacles, for example, are extremely tolerant to oil exposure but would die if smothered by it (Suchanek, 1993).

Locations closest to the oil spill would have elevated contaminant levels in sediments. Deposition of sedimented oil is anticipated to begin occurring within days or weeks of the spill and may be fairly deep (Ganning et al., 1984; Gómez Gesteira and Dauvin, 2000). Oily sand layers were reported to be 10 cm (4 in) deep on the seafloor near the *Amoco Cadiz* spill (Gómez Gesteira and Dauvin, 2000). Acute toxicity may occur near the spill, eliminating benthic communities. As the benthic species recolonize, the area there would be a reduced trophic diversity and an increase in opportunistic pollution tolerant species (Gaston et al., 1998).

Those species that can tolerate the disturbed or contaminated environment and can recruit from neighboring or nearby areas rapidly would be the initial colonizers of the impacted area. Recolonization and immigration by organisms from neighboring soft-bottom substrate to the impacted areas would be expected to occur within a relatively short period of time. Initial repopulation from nearby stocks may begin with the following recruitment event and be predominantly comprised of pioneering species, such as tube-dwelling polychaetes or oligochaetes (Rhodes and Germano, 1982). The contaminated or disturbed area would be initially dominated by small, opportunistic, subsurface deposit feeders that inhabit the sediment water interface and are more tolerant of contaminants (Gaston et al., 1998). Two pioneering Capitellid polychaetes in the Gulf of Mexico known to tolerate environmental stress are *Mediomastus californiensis* and *Notomastus latericeus*, and they would be the first to inhabit recovering areas (Gaston et al., 1998). Amphipods on the other hand, especially of the genus *Ampelisca*, are extremely sensitive to oil pollution and would not be found in the early recovery stages after hydrocarbon pollution (Gómez Gesteira and Dauvin, 2000). Full recovery would follow as later stages of successional communities overtake the opportunistic species (Rhodes and Germano, 1982), but the time it takes to reach a climax community may vary depending on the species and degree of impact. Initial recovery should be well advanced within a year following the deposition (Neff, 2005). Because some benthic communities in the northern Gulf of Mexico are permanently in early community successional stages due to frequent disturbances, full recovery may occur very quickly (Rabalais et al., 2002; Gaston et al., 1998; Diaz and Solow, 1999).

Experiments and field data indicate that benthic recovery would take approximately 1 year to occur. For example, a study of the recolonization and succession of subtidal macrobenthos in sediment contaminated with petroleum hydrocarbons indicated that recovery to pre-oiling conditions took 11 months (Lu and Wu, 2006). Initial colonization occurred within the first month of the study and polychaetes dominated the population (Lu and Wu, 2006). A crest after 3 months occurred with polychaetes being dominant, then at 6 months a peak occurred with bivalves dominating, followed by a decline in number of organisms and a leveling off of the community at 11 months (Lu and Wu, 2006). A similar time scale was observed in Corpus Christi Bay, Texas, where recovery from dredge material placement occurred after 1 year (Wilber et al., 2008). Recovery of benthic populations in soft subtidal environments, however, has been reported to take up to 5-10 years after oiling (Ganning et al., 1984; Gómez Gesteira and Dauvin, 2000). The overall recovery would depend on the extent of oiling, presence of recolonizers nearby, time of year for reproduction of those colonizers, currents and water circulation patterns, and the ability of the recolonizers to tolerate the sediment conditions (Ganning et al., 1984).

Certain species are more sensitive to oil than others. Crustaceans, for example, are very sensitive to oil and have disappeared from oiled environments and had slow returns to the oiled areas (Dean and Jewett, 2001; Gómez Gesteria and Dauvin, 2000). The amphipod, *Ampelisca* sp., which disappeared from some sediments after the *Amoco Cadiz* oil spill, took 2 years to begin repopulating areas, as the sediments decreased in contamination (Gómez Gesteira and Dauvin, 2000). Polychaetes, on the other hand, are much less sensitive to oil pollution and may experience population booms in contaminated areas (Gómez Gesteira and Dauvin, 2000).

The benthic population may be altered following an oil spill, and the return to pre-spill conditions may take many years. Opportunistic species are usually the first to occupy contaminated sediments, especially the polychaete, *Capitella capitata* (Sanders et al., 1980). Some polychaetes have been reported to have positive responses to oiling where they have greater densities at oiled sites compared with oil-free sites (Dean and Jewett, 2001). Concentrations as low as 10 ppm may alter benthic community structure (Gómez Gesteira and Dauvin, 2000).

An alteration in the benthic trophic structure may impact food availability for fish and invertebrates. Burrowing polychaetes and subsurface deposit feeders are not important in the diets of the red drum and spotted sea trout, two commercially and recreationally important species in the Gulf of Mexico (Gaston et al., 1998). Therefore, an increase in opportunistic species would result in less available food for certain species of fish (Gaston et al., 1998). The small, surface-dwelling opportunistic species, however, appear to be important in the diet of juvenile brown shrimp (McTigue and Zimmerman, 1998) and, therefore, may provide additional food sources for this species. Early stage successional communities, however, cannot store and regulate the nutritional energy that a later stage community can because the organisms are small and remain at the sediment surface, resulting in a less stable and productive food source for higher trophic levels (Diaz and Solow, 1999).

Oil may be persistent when deposited in soft-bottom habitats, and biodegradation rates may be slower than those in coarser sediments (Dean and Jewett, 2001; Whittle et al., 1982). The oil at the surface may be weathered by bacteria, but the oil that is buried may remain unchanged for long periods of time because oxygen is required to weather oil, and lower sediment layers may be anoxic (Whittle et al., 1982; Ganning et al., 1984). Infaunal benthic species may be very sensitive to the persistent oil in benthic sediments that do not experience rapid biodegradation (Ganning et al., 1984). Oil that penetrates deep into the sediment can also cause anoxia and toxicity to the infaunal population as a result (Ganning et al., 1984). Minimum residence time for oil deposited in offshore sediments is estimated to be 3-4 years (Ganning et al., 1984; Moore, 1976).

Long-term or low-level exposure may also occur to benthic infauna exposed to oil adhered to sediment. Mesocosm experiments using long-term, low-level concentrations of No. 2 fuel oil indicate acute toxicity to meiofauna due to direct oil contact and sublethal effects from sedimented oil and byproducts of the decomposition of the sedimented oil (Frithsen et al., 1985). Long-term exposure to low levels of fuel oil was shown to affect recruitment success; meiofaunal population recovery took between 2 and 7 months (Frithsen et al., 1985). These types of impacts would be expected farther from the well where oil concentrations were diluted with distance.

Some oiled particles may become widely dispersed as they travel with currents while they settle out of suspension. Sedimented oil may travel great distances from the spill site and could be deposited 1-2 years following the spill (Suchanek, 1993). Settling rates are determined by size and weight of the particle, salinity, and turbulent mixing in the area (Poirier and Thiel, 1941; Bassin and Ichiye, 1977; Deleersbijder et al., 2006). Because particles would have different sinking rates, the oiled particles would be dispersed over a large area, most likely at sublethal or immeasurable levels. Studies conducted after the *Ixtoc* oil spill revealed that, although oil was measured on particles in the water column, measurable petroleum levels were not found in the underlying sediment (ERCO, 1982). Based on the settling rates and behavior of sedimented oil, the majority of organisms that may be exposed to sedimented oil are anticipated to experience low-level concentrations.

Research on oil spilled from the Chevron Main Pass Block 41C Platform into the Gulf of Mexico has indicated that oil in bottom sediments can weather rapidly, leaving only a small percentage of the oil in the sediments after a year (McAuliffe et al., 1975). Substantial weathering was noted 1 week and 1 month after the Chevron Main Pass spill, and the oil remained in the top 1.5 in (3.8 cm) of the sediment. Benthic community fluctuations could not be correlated to the oil in the sediment from this oil spill, and the numbers of brown and white shrimp and blue crabs in the area of the oil spill did not appear to decrease 3 months or 1 year after the spill (McAuliffe et al., 1975).

The toxicity of the oil is greatly reduced by the time it reaches the seafloor as a result of weathering in the water column (Ganning et al., 1984). The *Ixtoc* blowout flowed for 290 days and resulted in an estimated 120,000 metric tons of oil reaching the seafloor (Jernelöv and Lindén, 1981). Oil reached the seafloor in small droplets in the offshore waters, although some aggregates formed nearshore. The approximate concentration of oil on the seafloor was 1 g/m^2, which is not high enough to cause substantial damage to a benthic ecosystem (Jernelöv and Lindén, 1981). Surface sediment samples collected mid- and post-spill did not reveal any hydrocarbons from the *Ixtoc* spill; however, hydrocarbons from this source were identified on suspended sediment in the water column (ERCO, 1982). These data show that the oil may take some time to reach the seafloor and when it does, it is widely dispersed and weathered.

As with the Chevron Main Pass spill, depressions in the benthic community during and following the *Ixtoc* spill could not be linked to the oil because hydrocarbons from the blowout were not present in sediment samples (ERCO, 1982). The benthic populations were depressed following the spill compared with pre-spill conditions; however, environmental evidence was not strong enough to separate oil impacts from natural variation or possible storm damage impacts (Tunnell et al., 1981). Oil may have been present in the sediment and affected benthic communities but weathered before sampling occurred, or oil in the water column may have affected species, but these possible factors were not measured (Rabalais, 1990).

Regardless of these hypotheses, field measurements indicate that the concentrations of oil that reached the seafloor were low even after uncontrolled flow for a long period of time, and the oil was vastly dispersed by the time it reached the seafloor. Inability to measure hydrocarbons in the sediment after the spill suggested that any oil that reached the seafloor had weathered rapidly. It is anticipated that similar dispersion of oil, rapid weathering, and resultant low-level, widespread concentrations of oil on the seafloor may be measured from similar blowouts.

Weathered oil is less toxic than freshly spilled oil because the remaining constituents are the larger, less bioavailable compounds (Ganning et al., 1984). The oil deposited on the seafloor is weathered from traveling in the water column and has lost a majority of its toxic compounds (Beiras and Saco-Álvarez, 2006). For example, amphipods, which are very sensitive to petroleum hydrocarbons, do not experience the level of toxicity when exposed to weathered oil that they do to fresh oil (Gómez Gesteira and Dauvin, 2000). Therefore, the majority of the oil that is on the seafloor would most likely result in sublethal impacts rather than acute toxicity, except for oil that may be rapidly deposited on the seafloor near the source of the spill.

Blowout and Sedimentation

Oil or gas well blowouts are possible occurrences in the OCS. Benthic communities exposed to large amounts of resuspended sediments following a subsurface blowout could be subject to sediment suffocation and exposure to toxic contaminants. Sediment deposition may smother benthic organisms, decreasing gas exchange, increasing exposure to anaerobic sediment, and causing physical abrasion (Wilber et al., 2005). Should oil or condensate be present in the blowout flow, liquid hydrocarbons could be an added source of negative impact on the benthos.

In rare cases, a portion or the entire rig may sink to the seafloor as a result of a blowout. The benthic communities on the seafloor upon which the rig settles would be destroyed or smothered. A settling rig may suspend sediments, which may smother nearby benthic communities as the sediment is redeposited on the seafloor. The habitats beneath the rig may be permanently lost; however, the rig itself may become an artificial reef upon which epibenthic organisms may settle. The rig may add to the contaminants in the local area by leaking stores of fuel, oil, well treatment chemicals, and other toxic substances. The surrounding benthic communities that were smothered by sediment would repopulate from nearby stocks through spawning recruitment and immigration.

Soft-bottom infaunal communities that are smothered or lost would be recolonized by populations from neighboring soft-bottom substrate. Recolonization would begin with the next recruitment cycle of the surrounding populations or from species immigration from surrounding stocks and may maintain a stronghold in the area until community succession begins (Rhodes and Germano, 1982; Sanders et al., 1980). Repopulation and succession in a disturbed bay off coastal Texas occurred within a year (Wilber et al., 2008).

Response Activity Impacts

Oil-spill-response activity may also affect sessile benthic communities. Continued localized disturbance of soft-bottom communities may occur during oil-spill-response efforts. Anchors used to set booms to contain oil or vessel anchors in decontamination zones may affect infaunal communities in the response activity zone. Infaunal communities may be altered in the anchor scar, and deposition of suspended sediment may result from setting and resetting of anchors. Anchors may also destroy submerged vegetation, altering benthic habitat (Dean and Jewett, 2001). The disturbed benthic community should begin to repopulate from the surrounding communities during their next recruitment event and through immigration of organisms from surrounding stocks. Any decontamination activities, such as cleaning vessel hulls of oil, may also contaminate the sediments of the decontamination zone, as some oil may settle to the seabed impacting the underlying benthic community.

If a blowout occurs at the seafloor, drilling muds (primarily barite) may be pumped into a well in order to "kill" it. If a kill is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath heavy layers of the extruded drilling mud would be buried. Base fluids of drilling muds are designed to be low in toxicity and biodegradable in offshore marine sediments (Neff et al., 2000). However, as bacteria and fungi break down the drilling fluids, the sediments may be come anoxic (Neff et al., 2000). Benthic macrofaunal recovery would occur when drilling mud concentrations are reduced to levels that enable the sediment to become reoxygenated (Neff et al., 2000). Complete community recovery from drilling mud exposure may take 3-5 years, although microbial degradation of drilling fluids, followed by an influx of tolerant opportunistic species, is anticipated to begin almost immediately (Neff et al., 2000).

Proposed Action Analysis

As described above, a subsurface spill or plume may impact soft-bottom benthic communities. As described in **Table 3-5** of this Supplemental EIS and Table 4-35 of the Multisale EIS, BOEMRE estimated the potential number of accidental events likely to occur during the 40-year leasing scenario for the OCS Program. The likelihood of a catastrophic spill remains remote; however, the types and kinds of impacts to soft-bottom communities from such a low-probability catastrophic spill would likely be similar to those expected from a more typical accidental event at a community level. Oil or dispersed oil may cause lethal or sublethal impacts to benthic organisms wherever a plume may contact them. Oil or dispersed oil may cause lethal or sublethal impacts to benthic organisms wherever a plume may contact them. Impacts may include loss of habitat and biodiversity, contamination of substrate, change in community structure, toxicity to larvae and embryos, and failed reproductive success. Sedimented oil or sedimentation as a result of a blowout would impact benthic organisms, although the greatest impact would be to those organisms closest to the spill. Communities farther from the spill may experience low-level exposure and possibly sublethal impacts. It is important to note that soft sediments cover a majority of the seafloor of the Gulf of Mexico and any impacts incurred, even lethal exposures, would not impact the overall population of soft-bottom benthic organisms that inhabit the seafloor of the Gulf of Mexico. Any local communities that are lost would be repopulated fairly rapidly (Neff, 2005). Those communities that are continuously in an early successional stage would reach their previous community composition rapidly, in as little as 1 year (Gaston et al., 1998).

Summary and Conclusion

Because of the small amount of proportional space that OCS activities occupy on the seafloor, only a very small portion of the seafloor of the Gulf of Mexico would experience lethal impacts as a result of blowouts, surface, and subsurface oil spills and the associated affects. The greatest impacts would be closest to the spill, and impacts would decrease with distance from the spill. Contact with spilled oil at a distance from the spill would likely cause sublethal to immeasurable effects to benthic organisms because the distance of activity would prevent contact with concentrated oil. Oil from a subsurface spill that reaches benthic communities would be primarily sublethal, and impacts would be at the local community level. Any sedimentation and sedimented oil would also be at low concentrations by the time it reaches benthic communities far from the location of the spill, also resulting in sublethal impacts. Also, any local communities that are lost would be repopulated fairly rapidly (Neff, 2005). Although an oil spill may have some detrimental impacts, especially closest to the occurrence of the spill, the impacts may be no greater than natural biological fluctuations (Clark, 1982), and impacts would be to an extremely small portion of the overall Gulf of Mexico.

4.1.1.19.1.4. Cumulative Impacts

This cumulative analysis considers the effects of impact-producing factors related to soft bottoms of the Gulf of Mexico continental shelf. The proposed action plus those related to prior and future OCS lease sales are considered; in this discussion, these are referred to as "OCS-related" factors. Other impacting factors that may occur and adversely affect soft-bottom benthic communities include shipping operations, cable and pipeline laying, bottom trawling, hypoxia (low oxygen levels ≤2 ppm), and storm events. The vast majority of the Gulf of Mexico seabed is comprised of soft sediments and drilling is focused on these sediments, so the greatest number of impacts occurs on soft-bottom benthic environments. Specific OCS-related, impact-producing factors considered in the analysis are structure emplacement and removal, anchoring, discharges from well drilling, produced waters, pipeline emplacement, oil spills, blowouts, and operational discharges. Non-OCS-related impacts, including commercial fisheries, natural disturbances, anchoring by recreational boats, and other non-OCS commercial vessels, as well as spillage from import tankering, all have the potential to damage soft-bottom benthic communities.

There are no BOEMRE stipulations that require avoidance of soft-bottom benthic communities because they are so ubiquitous throughout the seafloor of the Gulf of Mexico; most of the 115,645 km^2 (44,651 mi^2) of the WPA are soft mud bottoms; they are the substrate upon which well drilling occurs. It is important to note, however, that because the soft-bottom benthic communities comprise a majority of the seafloor of the Gulf of Mexico, impacts are not detrimental to the overall population of these habitats across the Gulf of Mexico. Also, because a large portion of the seafloor is subject to natural fluctuations and physical disturbances (such as storms and yearly hypoxic events), a permanent early successional community occupies much of the seafloor and enables rapid recovery of disturbed areas.

Severe physical damage may occur to soft-bottom sediments and the associated benthic communities as a result of non-OCS activities. It is assumed infauna associated with soft-bottom sediments of the WPA are well adapted to natural disturbances such as turbidity and storms. However, human disturbance, such as trawling or non-OCS activity oil spills, could cause severe damage to infauna, possibly leading to changes of physical integrity, species diversity, or biological productivity. If such events were to occur, recovery to pre-impact conditions could take approximately a year (Lu and Wu, 2006; Neff, 2005), with the overall recovery time depending on the extent of oiling, presence of recolonizers nearby, time of year for reproduction of those colonizers, currents and water circulation patterns, and the ability of the recolonizers to tolerate the sediment conditions (Ganning et al., 1984). Recovery of benthic populations in soft subtidal environments, however, have been reported to take up to 5-10 years after oiling (Ganning et al., 1984; Gómez Gesteira and Dauvin, 2000). However, because some benthic communities in the northern Gulf of Mexico are permanently in early community successional stages due to frequent disturbances, full recovery may occur very quickly (Rabalais et al., 2002; Gaston et al., 1998; Diaz and Solow, 1999).

Non-OCS activities have a greater potential to affect the soft-bottom communities of the region than BOEMRE-regulated activities. Natural events such as storms, extreme weather, and fluctuations of environmental conditions may impact soft-bottom infaunal communities. Soft-bottom communities occur from the shoreline into the deep waters of the Gulf of Mexico. Storms can physically affect shallow bottom environments, causing an increase in sedimentation, burial of organisms by sediment, a rapid change in salinity or dissolved oxygen levels, storm surge scouring, remobilization of contaminants in the sediment, and abrasion and clogging of gills as a result of turbidity (Engle et al., 2008). Storms have also been shown to uproot benthic organisms from the sediment and suspend organisms in the water column (Dobbs and Vozarik, 1983). Large storms may devastate infaunal populations; for example, 2 months after Hurricane Katrina, a significant decrease in the number of species, species diversity, and species density occurred in coastal waters off Louisiana, Mississippi, and Alabama (Engle et al., 2008). Such impacts may be devastating to a benthic community.

Hypoxic conditions of inconsistent intensities and ranges also occur annually in a band that stretches along the Louisiana-Texas shelf each summer (Rabalais et al., 2002). The dissolved oxygen levels in the Gulf of Mexico hypoxic zone are <2 ppm. Such low concentrations are lethal to many benthic organisms and may result in the loss of some benthic populations. Recolonization of devastated areas by populations from unaffected neighboring soft-bottom substrate would be expected to occur within a relatively short period of time (Dubois et al., 2009; Thistle, 1981).

Recreational boating, fishing, and import tankering may have limited impact on soft-bottom communities. Ships anchoring near major shipping fairways of the WPA or recreational fishing boats setting anchor would impact bottom habitats. Anchor placement may crush and eliminate infauna in the footprint of the anchor.

Damage resulting from commercial fishing, especially bottom trawling, may have a severe impact on soft-bottom benthic communities. Bottom trawling in the Gulf of Mexico primarily targets shrimp from nearshore waters to depths of approximately 90 m (295 ft) (NRC, 2002), which are the depths where the greatest trawling impacts are anticipated. Studies have indicated that trawled seafloor has reduced species diversity compared with untrawled seafloor (McConnaughey et al., 2000). Trawl trails may scour sediment, killing infauna, and epifaunal organisms may be physically removed (Engel and Kvitek, 1998). Trawling also contributes regularly to turbidity, as nets drag the seafloor, leaving trails of suspended sediment. Repetitive disturbance by trawling activity may lead to a community dominated by opportunistic species (Engel and Kvitek, 1998). Recovery from the passing of a trawl net would begin to occur with the following reproduction cycle of surrounding benthic communities (Rhodes and Germano, 1982), but populations may be severely impacted by repetitive trawling activity (Engel and Kvitek, 1998).

Structure placement and anchor damage from support boats and ships, floating drilling units, and pipeline-laying vessels are oil and gas OCS-related threats that disturb areas of the seafloor. The size of the areas affected by chains associated with anchors and pipeline-laying barges would depend on the water depth, chain length, sizes of anchor and chain, method of placement, wind, and current (Lissner et al., 1991). Anchor damage could result in the crushing and smothering of infauna. Anchoring often destroys a wide swath of habitat by being dragged over the seafloor or by the vessel swinging at anchor, causing the anchor chain to drag over the seafloor (Lissner et al., 1991). Damage to infauna as a result of anchoring may take approximately 1 year to recover, depending on the reproductive cycle and immigration of surrounding communities (Rhodes and Germano, 1982).

Both explosive and nonexplosive structure-removal operations disturb the seafloor; however, they are not expected to affect soft-bottom communities because many sessile benthic organisms are known to resist the concussive force of structure-removal-type blasts (O'Keeffe and Young, 1984). O'Keeffe and Young (1984) also noted ". . . no damage to other invertebrates such as sea anemones, polychaete worms, isopods, and amphipods." Impacts to invertebrates are anticipated to be minimal as they do not have air bladders inside their bodies that may burst with explosions, as some fish do (Schroeder and Love, 2004).

Routine discharges of drilling muds and cuttings by oil and gas operations could affect biological communities and organisms through a variety of mechanisms, including the smothering of organisms through deposition or less obvious sublethal toxic effects (impacts to growth and reproduction). Smothering of infauna by drilling discharges may be one of the greatest impacts to localized communities near a well, especially one that has shunted its cuttings to the seafloor to protect surrounding sensitive features. The heaviest concentrations of well cuttings and drilling fluids, for both water-based and synthetic-based drilling muds, have been reported within 100 m (328 ft) of wells and are shown to decrease beyond that distance (CSA, 2004b; Kennicutt et al., 1996). Although impacts are locally drastic, cumulative impacts over the seafloor of the Gulf of Mexico are anticipated to be very small, as such comparatively small areas are affected.

Produced waters from petroleum operations are not likely to have a great impact on soft-bottom communities. Produced waters are rapidly diluted and impacts are generally only observed within proximity of the discharge point, and acute toxicity that may result from produced waters occurs "within the immediate mixing zone around a production platform" (Gittings et al., 1992a; Holdway, 2002). There have been no reported impacts to marine organisms or sediment contamination beyond 100 m (328 ft) of the produced-water discharge (Neff and Sauer, 1991; Trefry et al., 1995). Therefore, impacts to infauna are anticipated to be localized and only affect a small portion of the entire seafloor of the Gulf of Mexico.

Traditional pipeline-laying barges (as opposed to dynamically positioned barges) affect more seafloor than other anchoring impacts. These barges typically use an array of 8-12 anchors weighing about 4,500 kg (10,000 lb) each. While the large anchors crush organisms in their footprint, a much larger area is affected by anchor cable sweep as the barge is pulled forward to lay the pipeline by reeling-in forward cables and reeling-out aft cables. The anchors are reset repeatedly to forward positions to allow the barge to "crawl" forward. In this way, the anchor sweep scours parallel paths on each side of the vessel where the cables touch the seafloor. The width of the scoured paths varies with water depth (deeper water equals longer cables) and may be as much as 1,500 m (5,000 ft) to each side (only a portion of the cable adjacent to the anchor touches the seafloor). Another major impact of the process is pipeline burial. In waters ≤60 m (200 ft), burial of pipelines is required. This involves trenching up to 3.3 m (10 ft) deep in the seafloor from a water depth of ≤60 m (200 ft) to shore. This is a severe disturbance of the trenched area and creates a large turbidity plume. Resuspended sediments can cause obstruction of filter-feeding mechanisms of sedentary organisms and gills of fishes. Adverse impacts from resuspended sediments would be temporary, primarily sublethal in nature, and the effects would be limited to areas in the vicinity of the barge. Impacts may include "changes in respiration rate, abrasion and puncturing of structures, reduced feeding, reduced water filtration rates, smothering, delayed or reduced hatching of eggs, reduced larval growth or development, abnormal larval development, or reduced response to physical stimulus" (Anchor Environmental CA, L.P., 2003).

Surface oil slicks released offshore can be moved toward shore by winds, but oil mixed into the water column is moved by water currents, which do not generally travel toward shore (Pond and Pickard, 1983). Surface oil spills and dispersed oil released from tankers may impact shallow, nearshore benthic communities. Disturbance of the sea surface by storms can mix surface oil 10-20 m (33-66 ft) into the water column (Lange, 1985; McAuliffe et al., 1975 and 1981a; Tkalich and Chan, 2002). This may result in direct oil contact for shallow, nearshore benthic communities. Direct oiling or exposure to water soluble fractions of oil may result in lethal impacts to organisms (Suchanek, 1993; Beiras and Saco-Álvarez, 2006; Byrne, 1989) or impaired embryonic development (Byrne and Calder, 1977; Nicol et al., 1977; Vashchenko, 1980). Benthic communities farther offshore, in deeper water, would be protected from direct physical contact of surface oil by depth below the sea surface. Any dispersed surface oil from a tanker or rig spill that may reach the benthic communities on the seafloor of the Gulf of Mexico at a depth greater than 10 m (33 ft) would be expected to be at very low concentrations (less than 1 ppm) (McAuliffe et al., 1981a and 1981b; Lewis and Aurand, 1997). Such concentrations may not be life threatening to adult stages, but they may harm larval or embryonic life stages of benthic organisms (Fucik et al., 1995; Suchanek, 1993; Beiras and Saco-Álvarez, 2006; Byrne, 1989).

Potential blowouts may impact the biota of the soft-bottom benthic communities. If any blowouts from wells occur, the suspended sediments should settle out of the water column fairly quickly, locally smothering benthic organisms near the well. Any oil that becomes entrained in a subsurface plume would be dispersed as it travels in the water column (Vandermuelen, 1982; Tkalich and Chan, 2002). Subsea oil plumes near the seafloor would pass over smooth soft bottom, continuing the processes of diffusion and biodegradation. These plumes would continue to be dispersed over a wide area in low concentrations with sublethal to immeasurable effect. If concentrated oil were to contact the soft-bottom communities directly, the impacts may include lethal effects with loss of habitat and biodiversity, contamination of substrate, change in community structure, and failed reproductive success. Damage to infauna as a result of subsurface plume exposure may take approximately 1 year to recover, depending on the reproductive cycle and immigration of surrounding communities (Rhodes and Germano, 1982). A recent report documents damage to a deepwater coral community 7 mi (11 km) southwest of the blowout. Soft bottoms in this area likely received oil also, but they would not be expected to catch as much oil as the benthic communities with greater relief above the seafloor (USDOI, BOEMRE, 2010j).

In November 2010, it was estimated that 26 percent of the released oil from the DWH event remained in the environment as oil on or just below the water surface as a light sheen or tarballs, oil that was washed ashore or collected from the shore, and oil that was in the sediments (Lubchenco et al., 2010). Currently, the bulk deposits of oil have been removed from beaches, and the remaining oil that reached shorelines has been buried (e.g., through wave action and hurricanes) and is weathering over time (OSAT-2, 2011). Oil that has been deposited on the floor of the Gulf has also weathered (OSAT, 2010). The greatest concentrations are expected to be near the wellhead and to decrease with distance from the source. The modes of transport to the seafloor discussed below are anticipated to only deliver a small amount of oil to the seafloor with decreasing concentrations from the well.

The cumulative impact to soft bottoms of possible future oil spills, along with the DWH event, is anticipated to be small. The limited data currently available on the impacts of the DWH event make it difficult to conclusively exclude impacts to the soft-bottom communities in the WPA; although, as described above, due to the distance of the WPA from the Macondo well and westernmost extent of the plume and sheen, it does not appear that soft-bottom communities in the WPA were affected. It appears that some impacts have occurred to corals within 7 mi (11 km) of the Macondo well in the CPA, and it is anticipated that the soft-bottom communities in the area were impacted as well but with a lower impact because smooth, flat seafloor would allow the oil plume to pass unimpeded. Water column sampling, however, indicated that concentrations of total petroleum hydrocarbons in the water column were less than 0.5 ppm, 40 and 45 nmi (74 and 83 km; 46 and 52 mi) northeast of the well (Haddad and Murawski, 2010). Therefore, the acute impacts of any large-scale blowout would likely be limited in scale, and any additive impacts of several blowouts should have acute effects in only small areas, with possible sublethal impacts occurring over a larger area. However, the locally impacted seafloor would be very small compared with the overall size of the seafloor of the WPA (115,645 km^2; 44,651 mi^2) and would not impact the overall infaunal population.

Summary and Conclusion

Non-OCS activities that may impact soft-bottom benthic substrate include recreational boating and fishing, import tankering, and natural events such as extreme weather conditions, and extreme fluctuations of environmental conditions. These activities could cause temporary damage to soft-bottom communities. Ships and fishermen anchoring on soft bottoms could crush and smother underlying organisms. During severe storms, such as hurricanes, large waves may stir bottom sediments, which cause scouring, remobilization of contaminants in the sediment, abrasion and clogging of gills as a result of turbidity, uprooting benthic organisms from the sediment, and an overall result in decreased species diversity (Engle et al., 2008; Dobbs and Vozarik, 1983). Yearly hypoxic events may eliminate many species from benthic populations over a wide area covering most of the CPA and part of the WPA continental shelf (Rabalais et al., 2002).

Impacts from routine activities of OCS oil and gas operations include anchoring, structure emplacement and removal, pipeline emplacement, drilling discharges, and discharges of produced waters. In addition, accidental subsea oil spills or blowouts associated with OCS activities can cause damage to infaunal communities. Long-term OCS activities are not expected to adversely impact the entire soft-bottom environment because the local impacted areas are extremely small compared with the entire seafloor of the Gulf of Mexico and because impacted communities are repopulated relatively quickly.

Impacts from blowouts, pipeline emplacement, muds and cuttings discharges, other operational discharges, and structure removals may have local devastating impacts, but the cumulative effect on the overall seafloor and infaunal communities on the Gulf of Mexico would be very small. Soft-bottom benthic communities are ubiquitous throughout and often remain in an early successional stage due to natural fluctuation, and therefore, the activities of OCS production of oil and gas would not cause additional severe cumulative impacts.

The incremental contribution of the proposed action to the cumulative impact is expected to be slight, with possible impacts from physical disturbance of the bottom, discharges of drilling muds and cuttings, other OCS discharges, structure removals, and oil spills. Non-OCS factors, such as storms, trawling, non-OCS-related spills, and hypoxia, are likely to impact the soft-bottom communities on a more frequent basis. Impacts from OCS activities are also somewhat minimized by the fact that these communities are ubiquitous through the WPA and can recruit quickly from neighboring areas.

4.1.1.19.2. Diamondback Terrapins

A description of diamondback terrapins as a resource has not been included in previous NEPA evaluations that were conducted by the BOEMRE Gulf of Mexico Region. Therefore, there is no prior discussion in the Multisale EIS or the 2009-2012 Supplemental EIS upon which to tier this information. However, the diamondback terrapin is a Federal species of concern and is currently being assessed under the NRDA process for potential post-DWH impacts and is thus included within this Supplemental EIS.

4.1.1.19.2.1. Description of the Affected Environment

Diamondback terrapins occur in 16 states along the Atlantic and Gulf Coasts; the coastline of Florida represents approximately 20 percent of their entire range (Butler et al., 2006). The one subspecies of terrapin that occurs in the WPA and that is a Federal species of concern is the Texas diamondback terrapin (*Malaclemys terrapin littoralis*). The Texas diamondback terrapin (listed November 15, 1994) has a range from Louisiana through Texas (USDOI, FWS, 2010).

Terrapins inhabit brackish waters, including coastal marshes, tidal flats, creeks, and lagoons behind barrier beaches (Hogan, 2003). Juveniles spend the first years of their life under mats of tidal wrack and flotsam. Terrapins meet the osmotic challenges of a saline environment with several behavioral, physiological, and anatomical adaptations (U.S. Dept. of the Army, COE, 2002). Their diet consists of fish, snails, worms, clams, crabs, and marsh plants (Cagle, 1952).

Female Florida terrapins on the east coast reach sexual maturity at a plastron length of 135 mm (5 in) or 4-5 years of age; male Florida terrapins mature at 95 mm (4 in) about age 2-3 years (Butler et al., 2006). Although not definitively known, Texas terrapins would be expected to have similar life cycles. Reproductive activities vary throughout the terrapin range. Courtship and mating occur in March and April, and the nesting season extends through July (U.S. Dept. of the Army, COE, 2002). Terrapins nest on dunes, beaches, sandy edges of marshes, islands, and dike roads (Roosenburg, 1994). The common factor for proper egg development is sandy soil, which does not clog eggshell pores, thus allowing sufficient gas exchange between the developing embryo and the environment (Roosenburg, 1994). Nesting occurs primarily in the daytime during high tide on high sand dunes with gentle slopes and minimal vegetation (Burger, 1977). Clutch size ranges from 4 to 22 eggs, and incubation time ranges from 61 to 104 days (Butler et al., 2006; Burger, 1977). Female terrapins may nest 2-3 times in the same nesting season. Gender determination is temperature-dependent. Hatching occurs from August through October in northern populations (Burger, 1977).

Severely depleted by commercial harvest for food a century ago, diamondback terrapins are currently threatened by drowning in crab pots, development of shoreline habitats and nesting beaches, predation of nests and adults, boat strikes, and road mortality (Butler et al., 2006). Spending most of their lives at the aquatic-terrestrial boundary in estuaries, terrapins are susceptible to habitat destruction from cleanup efforts, as well as direct catastrophic oil contact; however, most impacts cannot be quantified at this time. Tropical storms, hurricanes, and beach erosion threaten their preferred nesting habitats. The actual impacts of these storms on the animals in the Gulf and the listed species have not yet been determined and, for the most part, may remain very difficult to quantify. However, some impacts, such as loss of beach habitat, are known to have occurred and impact terrapin populations that would have used those areas for nesting beaches.

Given that the boundary of the WPA is more than 300 mi (483 km) from the Macondo well and that the westernmost extent of the plume and sheen did not reach the WPA, it appears that Texas terrapins would not have been impacted by the DWH event. Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). The DWH event and associated oil spill is unlikely to have impacted the terrapin community and associated brackish habitats, although minimal oil (in the form of a small number of tarballs that are believed to have formed from transported in by vessel) reached the waters of the WPA. The *Deepwater Horizon* Unified Command reports daily fish and wildlife collection reports that include turtles; this can be found at RestoreTheGulf.gov (2010b, last accessed June 29, 2011).

As of April 20, 2011, two other reptiles (not yet identified as terrapin and other than sea turtles) have been collected in the CPA (RestoreTheGulf.gov, 2010b, last accessed June 29, 2011). No known terrapins have been collected in Texas to date. As data continue to be gathered and impact assessments completed, a better characterization of the full scope of impacts to the terrapin populations in the GOM from the DWH event will be available. The DWH event and associated oil spill has impacted the turtle community in the GOM. Impacts can be either direct (mortality or injury) or indirect (e.g., reduced prey availability); however, most impacts cannot be quantified at this time.

The final determinations on damages to diamondback terrapin resources from the DWH event will ultimately be made through the NRDA process, although current data indicate that the Macondo spill never reached terrapins and their brackish habitats in the WPA. The DWH event will ultimately allow a better understanding of any realized effects from such a low-probability catastrophic spill. However, the best available information on impacts to diamondback terrapins does not yet provide a complete understanding of the effects of the oil spilled and active response/cleanup activities from the DWH event on diamondback terrapins as a whole in the GOM and whether these impacts reach a population level. The BOEMRE concludes that the unavailable information from these events may be relevant to foreseeable significant adverse impacts to diamondback terrapins in the WPA. Relevant data on the status of diamondback terrapin populations after the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeframe contemplated in this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEMRE subject-matter experts have used available scientifically credible evidence in this analysis and based upon accepted methods and approaches.

Nevertheless, a complete understanding of the missing information is not essential to a reasoned choice among the alternatives for this Supplemental EIS (including the No Action and Action Alternatives). There are 1,394 active leases in the WPA with ongoing (or the potential for) exploration, drilling, and production activities. In addition, non-OCS energy-related activities will continue to occur in the WPA irrespective of this proposed lease sale (i.e., crabbing, fishing, military activities, scientific research, and shoreline development). The potential for effects from changes to the Affected Environment (post-DWH), Routine Activities, Accidental Spills (including low-probability catastrophic spills), and Cumulative Effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on diamondback terrapins from either smaller accidental events or low-probability catastrophic events will remain the same.

Further, the analyses within this Supplemental EIS and **Appendix B**, all conclude that low-probability catastrophic events are not expected to result in significant, population-level effects on affected diamondback terrapin species. The BOEMRE continues to agree with these conclusions irrespective of any incomplete information, changes to the existing environment from the DWH event or even the effectiveness of implementation of the improved post-DWH safety and oil-spill-response requirements.

4.1.1.19.2.2. Impacts of Routine Events

Background/Introduction

The major impact-producing factors resulting from the routine activities associated with the WPA proposed action that may affect the Texas diamondback terrapin (*Malaclemys terrapin littoralis*) include beach trash and debris generated by service vessels and OCS facilities, efforts undertaken for the removal of marine debris or for beach restoration, and vessel traffic with associated habitat erosion.

Proposed Action Analysis

The major routine impact-producing factors associated with the WPA proposed action that may affect terrapins include beach trash and debris and efforts undertaken for the removal of marine debris or for beach restoration. Greatly improved handling of waste and trash by industry, along with the annual awareness training required by the marine debris mitigations, is decreasing the plastics in the ocean and minimizing the devastating effects on wildlife. The incidental ingestion of marine debris and entanglement could adversely affect terrapins. The BOEMRE proposes compliance with the established guidelines provided in NTL 2007-G03, "Marine Trash and Debris Awareness and Elimination," which appreciably reduces the likelihood of encountering marine debris from the proposed activity. The proposed action is expected to contribute negligible marine debris or disruption to terrapin habitat. Unless properly regulated, personnel removing marine debris may temporarily disturb terrapins or trample nesting sites. Due to the extended distance from shore, most impacts associated with activities associated with the OCS Program are not expected to impact terrapins or their habitat.

There have been no documented terrapin collisions with drilling and service vessels in the GOM. To further minimize the potential for vessel strikes, BOEMRE issued NTL 2007-G04, which clarifies 30 CFR 250.282 and provides NMFS guidelines for monitoring procedures related to vessel strike avoidance measures. The BOEMRE monitors for any takes that have occurred as a result of vessel strikes and also requires that any operator immediately report the striking of any marine animal (see 30 CFR 250.282 and NTL 2007-G04). Other potential impacts that are indirectly associated with OCS energy-related activities are wake erosion of terrapin habitat resulting from vessel traffic and additional onshore development. However, only a small amount of the routine dredging done in coastal areas would be directly or indirectly due to the proposed action.

Little or no damage is expected to the physical integrity, species diversity, or biological productivity of terrapin habitat as a result of the WPA proposed action.

Summary and Conclusion

Adverse impacts due to routine activities resulting from the WPA proposed action are possible but unlikely. Because of the greatly improved handling of waste and trash by industry, and the annual awareness training required by the marine debris mitigations, the plastics in the ocean are decreasing and the devastating effects on offshore and coastal marine life are minimizing. The routine activities of the WPA proposed action are unlikely to have significant adverse effects on the size and recovery of any terrapin species or population in the Gulf of Mexico. Most routine OCS energy-related activities are expected to have sublethal effects, such as behavioral effects, that are not expected to rise to the level of significance to the populations.

Although there will always be some level of incomplete information on the effects from routine activities under this proposed action on diamondback terrapin, there is credible scientific information, applied using acceptable scientific methodologies, to support the conclusion that any realized impacts would be sublethal in nature and not in themselves rise to the level of reasonably foreseeable significant adverse (population level) effects. Also, routine activities will be ongoing in the proposed action area (WPA) as a result of existing leases and related activities. (In the WPA, there are 1,394 active leases (USDOI, BOEMRE, 2011). Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that routine activities from the pre-existing OCS program are significantly impacting diamondback terrapin populations. Therefore, a full understanding of any incomplete or unavailable information on the effects of routine activities is not essential to make a reasoned choice among the alternatives.

4.1.1.19.2.3. Impacts of Accidental Events

Background/Introduction

The major impact-producing factors resulting from the accidental activities associated with the WPA proposed action that may affect the Texas diamondback terrapin (*Malaclemys terrapin littoralis*) include offshore and coastal oil spills and spill-response activities.

Proposed Action Analysis

Accidental blowouts, oil spills, and spill-response activities resulting from the WPA proposed action have the potential to impact small to large numbers of terrapins within their habitat, depending on the magnitude and frequency of accidents, the ability to respond to accidents, the location and date of accidents, and various meteorological and hydrological factors. Populations of terrapins in the western Gulf may be exposed to residuals of oils spilled as a result of the proposed action during their lifetimes. Chronic or acute exposure may result in the harassment, harm, or mortality to terrapins occurring in the western Gulf. In most foreseeable cases, exposure to hydrocarbons persisting within the wetlands following the dispersal of an oil slick could result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease). Terrapin hatchling exposure to, fouling by, or consumption of tarballs persisting inland following the dispersal of an oil slick would likely be fatal but unlikely.

Burger (1994) described the behavior of 11 female diamondback terrapins that were oiled during the January 1990 spill of No. 2 fuel oil in Arthur Kill, New York. The terrapins were hibernating at the time of the spill, and when they emerged from hibernation, they were found to be oiled. The terrapins voided oil from their digestive tracks for 2 weeks in rehabilitation. At 3 weeks, the terrapins scored low on strength tests and were slow to right themselves when placed on their backs. At 4 weeks, they developed edema and appetite suppression. Eight of the 11 died; these animals had traces of oil in their tissues and exhibited lesions in their digestive tract consistent with oil exposure (Burger, 1994).

The DWH event and associated oil spill may have potentially impacted the terrapin community, although only minimal oil reached the waters of the WPA. Impacts from a catastrophic spill may impact terrapin communities (**Appendix B**). Impacts can be either direct (mortality or injury) or indirect (e.g., reduced prey availability); however, most impacts cannot be quantified at this time. The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on the potentially affected terrapin environment; however, the WPA estuarine environments were not affected by the DWH event.

Accidental blowouts, oil spills, and spill-response activities resulting from the WPA proposed action have the potential to impact small to large numbers of terrapins within their habitat, depending on the magnitude and frequency of accidents, the ability to respond to accidents, the location and date of accidents, and various meteorological and hydrological factors. Populations of terrapins in the western Gulf may be exposed to residuals of oils spilled as a result of the proposed action during their lifetimes. Chronic or acute exposure may result in the harassment, harm, or mortality to terrapins occurring in the western Gulf. In most foreseeable cases, exposure to hydrocarbons persisting within the wetlands following the dispersal of an oil slick could result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease). Terrapin hatchling exposure to, fouling by, or consumption of tarballs persisting inland following the dispersal of an oil slick would likely be fatal but unlikely. Impacts from the dispersants are unknown, but they may have similar irritants to tissues and sensitive membranes as they are known to have had on seabirds and sea turtles (NRC, 2005). The impacts to diamondback terrapins from chemical dispersants could include nonlethal injury (e.g., tissue irritation, inhalation), long-term exposure through bioaccumulation, and potential shifts in distribution from some habitats.

Spending most of their lives at the aquatic-terrestrial boundary in estuaries, terrapins are susceptible to habitat destruction from cleanup efforts, as well as direct oil contact. Even after the oil is no longer visible, terrapins may still be exposed while they forage in the salt marshes lining the edges of estuaries where oil may have accumulated under the sediments and within the food chain. Nests can also be disturbed or destroyed by cleanup efforts.

Summary and Conclusion

Impacts on diamondback terrapins from smaller accidental events are likely to affect individual diamondback terrapins in the spill area, as described above, but are unlikely to rise to the level of population effects (or significance) given the probable size and scope of such spills. Further, the potential remains for smaller accidental spills to occur in the proposed action area, regardless of any alternative selected under this Supplemental EIS, given there are 1,394 active leases already in this area with either ongoing or the potential for exploration, drilling, and production activities.

The analyses within this Supplemental EIS and **Appendix B** conclude that there is a low probability for catastrophic spills, and **Appendix B** of this Supplemental EIS concludes that there is a potential for a low-probability catastrophic event to result in significant, population-level effects on affected diamondback terrapin species. The BOEMRE continues to concur with the conclusions from these analyses.

The BOEMRE concludes that there is incomplete or unavailable information that may lead to reasonably foreseeable significant adverse impacts to diamondback terrapins from accidental events. For example, there is incomplete information on impacts to diamondback terrapin populations from the DWH event, or that could result from a similar catastrophic spill. Relevant data on the status of and impacts to diamondback terrapin populations from the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeframe contemplated in this Supplemental EIS, regardless of the cost or resources needed. In the absence of this information, BOEMRE subject-matter experts have used what scientifically credible information that is available and applied using accepted scientific methodologies. The BOEMRE does not, however, believe this incomplete information is essential to make a reasoned choice among the alternatives primarily because activities that could result in an accidental spill in the WPA would be ongoing whether or not the lease sale under the proposed action of this Supplemental EIS occurred. At present, there are 1,394 active leases in the proposed action area that are engaged, or have the potential to be engaged, in drilling and/or production activities that could theoretically result in an accidental spill. Given these existing leases and this ongoing activity, any incomplete information that may lead to reasonable foreseeable significant adverse impacts to diamondback terrapins is not needed to make a reasoned choice among the alternatives, including the No Action alternative.

4.1.1.19.2.4. Cumulative Impacts

Background/Introduction

The major impact-producing factors resulting from the cumulative activities associated with the WPA proposed action that may affect the Texas diamondback terrapin (*Malaclemys terrapin littoralis*) include oil spills and spill-response activities, alteration and reduction of habitat, predation and competition, and consumption of trash and debris.

Most proposed action-related spills, as well as oil spills stemming from import tankering and prior and future lease sales, are not expected to contact terrapins or their habitats. Cumulative activities posing the greatest potential harm to terrapins are non-OCS factors (i.e., coastal spills) and natural catastrophes (i.e., hurricanes and tropical storms), which, in combination, could potentially deplete some terrapin populations to unsustainable levels. The expected incremental contribution of the WPA proposed action to the cumulative impacts is expected to be minimal.

Spending most of their lives within their limited home ranges at the aquatic-terrestrial boundary in estuaries, terrapins are susceptible to habitat destruction (i.e., urban development, subsidence/sea-level rise, direct oil contact, and associated cleanup efforts). Habitat loss has the potential to increase terrapin vulnerability to predation and increase competition. Behavioral effects and nonfatal exposure to or intake of OCS energy-related contaminants or discarded debris may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources. Even after the oil is no longer visible, terrapins may still be exposed while they forage in the salt marshes lining the edges of estuaries where oil may have accumulated under the sediments and within the food chain (Burger, 1994; Roosenburg et al., 1999). Nests can also be disturbed or destroyed by cleanup efforts.

Habitat destruction, road construction, and drowning in crab traps are the most recent threats to diamondback terrapins. In the 1800's, populations declined due to overharvesting for meat (Hogan, 2003). Tropical storms, hurricanes, and beach erosion threaten their preferred nesting habitats. Destruction of the remaining habitat due to a catastrophic spill and response efforts could drastically affect future population levels and reproduction. Characteristics of terrapin life history render this species especially vulnerable to overharvesting and habitat loss. These characteristics include low reproductive rates, low survivorship, limited population movements, and nest site fidelity year after year.

Given that the boundary of the WPA is more than 300 mi (483 km) from the Macondo well and that the westernmost extent of the plume and sheen did not reach the WPA (**Figure 1-2**), it appears that Texas terrapins would not have been impacted by the DWH event. Data collected by the Operational Science Advisory Team indicate that the DWH spill did not reach WPA waters or sediments (OSAT, 2010). The DWH event and associated oil spill is unlikely to have impacted the terrapin community and associated brackish habitats, although minimal oil (in the form of a small number of tarballs that are believed to have formed from transported in by vessel) reached the waters of the WPA. The DWH event and associated oil spill may have potentially impacted the terrapin community, although only minimal oil reached the waters of the WPA. Impacts can be either direct (mortality or injury) or indirect (e.g., reduced prey availability); however, most impacts cannot be quantified at this time and are believed to be negligible. As discussed in **Appendix B**, a low-probability, large-scale catastrophic event could have population-level effects on diamondback terrapins. The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on the potentially affected terrapin environment; however, the WPA estuarine environments were not affected by the DWH event.

The effects of the proposed action, when viewed in light of the effects associated with other past, present, and reasonably foreseeable future activities, may result in greater impacts to diamondback terrapins than before the DWH event; however, the magnitude of those effects cannot yet be determined. Nonetheless, to mitigate potential impacts from OCS-related energy activities, operators are required to follow all applicable lease stipulations and regulations, as clarified by NTL's, to minimize these potential interactions and impacts. The operator's reaffirmed compliance with NTL 2007-G04 ("Vessel-Strike Avoidance") and NTL 2007-G03 ("Marine Trash and Debris"), as well as the limited scope, timing, and geographic location of the proposed action, would result in negligible effects from the proposed drilling activities on diamondback terrapins. Therefore, no significant cumulative impacts to diamondback terrapins would be expected as a result of the proposed exploration activities when added to the impacts of past, present, or reasonably foreseeable oil and gas development in the area, as well as other ongoing activities in the area.

Summary and Conclusion

Texas diamondback terrapins have experienced impacting pressures from habitat destruction, road construction, drowning in crab traps, and past overharvesting resulting in historical reductions in their habitat range and declines in populations. Inshore oil spills from non-OCS energy-related sources are potential threats to terrapins in their brackish coastal marshes. Pipelines from offshore oil and gas and other shoreline crossings have contributed to marsh erosion. However, the current proposed action includes only limited shoreline crossings, and modern regulations require mitigation of wetland impacts. Catastrophic offshore oil spills could affect the coastal marsh environment but such events are rare occurrences and may not reach the shore if catastrophic spills do occur. Therefore, the incremental contribution of the proposed action is expected to be minimal. The major impact-producing factors resulting from the cumulative activities associated with the WPA proposed action that may affect the diamondback terrapin include oil spills and spill-response activities, alteration and reduction of habitat, and consumption of trash and debris. Due to the extended distance from shore, impacts associated with activities occurring in the OCS Program are not expected to impact terrapins or their habitat. No substantial information was found at this time that would alter the overall conclusion that cumulative impacts on diamondback terrapins associated with the WPA proposed action is expected to be minimal.

The BOEMRE has considered this assessment and reexamined the cumulative analysis for diamondback terrapins and the cited new information. Based on this evaluation, conclusions in these analyses on effects to diamondback terrapins remain unchanged in regards to Routine Activities (no potential for significant adverse effects) and Accidental Spills (potential for significant adverse effects).

Unavailable information on the effects to diamondback terrapins from the DWH event (and thus changes to the diamondback terrapin baseline in the Affected Environment) makes an understanding of the cumulative effects less clear, although current data indicate that the Macondo spill never reached terrapins and their brackish habitats in the WPA. Here, BOEMRE concludes that the unavailable information from these events may be relevant to foreseeable significant adverse impacts to diamondback terrapins. Relevant data on the status of diamondback terrapin populations after the DWH event may take years to acquire and analyze, and impacts from the DWH event may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEMRE to obtain this information within the timeframe contemplated in this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEMRE subject-matter experts have used available scientifically credible evidence in this analysis and based upon accepted methods and approaches.

Nevertheless, a complete understanding of the missing information is not essential to a reasoned choice among alternatives for this Supplemental EIS (including the No Action and Action Alternatives). There are 1,394 active leases in the WPA with ongoing (or the potential for) exploration, drilling, and production activities. In addition, non-OCS energy-related activities will continue to occur in the WPA irrespective of this proposed lease sale (i.e., crabbing, fishing, military activities, scientific research, and shoreline development). The potential for effects from changes to the Affected Environment (post-DWH), Routine Activities, Accidental Spills (including low-probability catastrophic spills), and Cumulative Effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on diamondback terrapins from either smaller accidental events or low-probability catastrophic events will remain the same.

Within the WPA, there is a long-standing and well-developed OCS program (more than 50 years); there are no data to suggest that activities from the pre-existing OCS program are significantly impacting diamondback terrapin populations. Therefore, in light of the above analysis on the proposed action and its impacts, the incremental effect of the proposed action on diamondback terrapins populations is not expected to be significant when compared with historic and current non-OCS energy-related activities, such as habitat loss, overharvesting, crabbing, and fishing.

4.1.2. Alternative B—The Proposed Action Excluding the Unleased Blocks Near Biologically Sensitive Topographic Features

Description of the Alternative

Alternative B differs from Alternative A (the proposed action) by not offering blocks that are possibly affected by the proposed Topographic Features Stipulation (**Chapter 2.3.1.3.1; Figure 2-1**). All of the assumptions (including the three other potential mitigating measures) and estimates are the same as for the proposed action (Alternative A). A description of Alternative A is presented in **Chapter 2.3.1.1**.

Effects of the Alternative

The following analyses are based on the scenario for the proposed action in the WPA (Alternative A). The scenario provides assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what would happen as a result of holding the proposed lease sale. A detailed discussion of the scenario and related impact-producing factors is presented in **Chapter 3.1**.

The analyses of impacts to the various resources under Alternative B are very similar to those for Alternative A. The reader should refer to the appropriate discussions under Alternative A for additional and more detailed information regarding impact-producing factors and their expected effects on the various resources. Impacts under Alternative B are expected to be the same as those under the WPA proposed action (**Chapter 4.1**) for the following resources:

— Air Quality
— Water Quality
— Coastal Barrier Beaches and Associated Dunes
— Wetlands
— Seagrass
— Topographic Features
— Sargassum
— Chemosynthetic and Nonchemosynthetic Communities
— Marine Mammals
— Sea Turtles
— Coastal and Marine Birds
— Fish Resources and Essential Fish Habitat
— Commercial Fishing
— Recreational Fishing
— Recreational Resources
— Archaeological Resources
— Human Resources and Land Use
— Soft Bottoms
— Diamondback Terrapins

The impacts to some Gulf of Mexico resources under Alternative B would be different from the impacts expected under the proposed action. These impacts are described below.

Impacts on Topographic Features

The sources and severity of impacts associated with this alternative are those sale-related activities discussed for the proposed action. The potential impact-producing factors to the topographic features of the WPA are anchoring and structure emplacement, drilling-effluent and produced-water discharges, blowouts, oil spills, and structure removal. A more detailed discussion of these potential impact-producing factors is presented in **Chapter 3.**

Impacts of Routine and Accidental Events

All 21 topographic features of the WPA are located within water depths less than 200 m (656 ft). These features occupy a very small portion of the entire area. Of the potential impact-producing factors that may affect the topographic features, anchoring, structure emplacement, and structure removal would be eliminated by the adoption of this alternative. Effluent discharge and blowouts would not be a threat to the topographic features because blocks near enough to the banks for these events to have an impact on the biota of the banks would have been excluded from leasing under this alternative. Thus, the only impact-producing factor remaining from operations in blocks included in this alternative (i.e., those blocks not excluded by this alternative) is an oil spill. The potential impacts from oil spills are summarized below and are discussed further in **Chapter 3.2.1**.

A subsurface spill would have to come into contact with a biologically sensitive feature to have an impact. A subsurface spill is expected to rise to the surface, and any oil remaining at depth would be swept clear of the banks by currents moving around the banks (Rezak et al., 1983). Deepwater subsurface spills may travel along the sea bottom or in the water column for some distance before rising to the surface. The fact that the topographic features are widely dispersed in the WPA, combined with the random nature of spill events, would serve to limit the likelihood of a spill occurring proximate to a topographic feature. Chapter 4.3.1.8 of the Multisale EIS discusses the risk of spills interacting with topographic features, especially the Flower Garden Banks, in more detail. The currents that move around the banks would likely steer any spilled oil around the banks rather than directly upon them, lessening impact severity. In the unlikely event that oil from a subsurface spill would reach the biota of a topographic feature, the effects would be primarily sublethal for most of the adult sessile biota. Lethal effects would probably be limited to a few coral colonies (in the case of the Flower Garden Banks National Marine Sanctuary) (CSA, 1992 and 1994). It is anticipated that recovery from a mostly sublethal exposure would occur within a period of 2 years. In the unlikely event that oil from a subsurface spill contacted a coral-covered area (in the case of the Flower Garden Banks), the areal extent of coral mortality would be limited, but long-lasting sublethal effects may be incurred by organisms surviving the initial effects of a spill (Jackson et al., 1989). Indeed, the stress resulting from the oiling of reef coral colonies could affect their resilience to natural disturbances (e.g., elevated water temperature, diseases) and may hamper their ability to reproduce. A complete recovery of such an affected area could take in excess of 10 years.

Cumulative Impacts

With the exception of the topographic features, the cumulative impacts of Alternative B on the environmental and socioeconomic resources of the WPA would be identical to Alternative A. The incremental contribution of the proposed action to the cumulative impacts on topographic features is expected to be slight, and negative impacts should be restricted by the implementation of the Topographic Features Stipulation and site-specific mitigations, the depths of the features, and water currents in the topographic feature area.

Summary and Conclusion

Alternative B, if adopted, would prevent any oil and gas activity whatsoever in the blocks containing topographic features; thus, it would eliminate any potential direct impacts to the biota of those blocks from oil and gas activities, which otherwise would be conducted within the blocks. In the unlikely event that oil from a subsurface spill contacts the biota of a topographic feature, the effects would be localized and primarily sublethal for most of the adult sessile biota. Some lethal effects would probably occur upon oil contact to coral colonies (in the case of the Flower Garden Banks National Marine Sanctuary); recovery from such an event is anticipated to occur within a period of 2 years.

4.1.3. Alternative C—No Action

Description of the Alternative

Alternative C is equivalent to cancellation of a lease sale scheduled for a specific period in the *Final Proposed Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012.* By canceling the proposed lease sale, the opportunity is postponed for development of the estimated 0.222-0.423 BBO and 1.495-2.647 Tcf of gas, some of which may be foregone. Any potential environmental and socioeconomic impacts resulting from the proposed lease sale (**Chapter 4.1.1**, Alternative A—The Proposed Action) would be postponed or not occur.

Effects of the Alternative

Under Alternative C, DOI cancels the proposed WPA lease sale. Therefore, the discovery and development of oil and gas expected from the lease sale would be delayed and a portion may not occur. The environmental and socioeconomic effects of Alternative A (the proposed action) also would be delayed or not occur.

This Agency published a report that examined previous exploration and development activity scenarios (USDOI, MMS, 2007g). The report compared forecasted activity with the actual activity from 14 WPA and 14 CPA lease sales.

The report shows that many lease sales contribute to the present level of OCS activity, and any single lease sale accounts for only a small percentage of the total OCS activities. In 2006, leases from 92 different sales contributed to Gulf of Mexico production, while an average WPA lease sale contributed to 3 percent of oil production and 3 percent of gas production in the WPA. In 2006, leases from

15 different sales contributed to the installation of production structures in the Gulf of Mexico, while an average WPA lease sale contributed to 6 percent of the installation of production structures in the WPA. In 2006, leases from 70 different sales contributed to wells drilled in the Gulf of Mexico, while an average WPA lease sale contributed to 6 percent of wells drilled in the WPA.

Like other lease sales, the proposed lease sale would contribute to maintaining the present level of OCS activity in the Gulf of Mexico. Exploration and development activity, including service-vessel trips, helicopter trips, and construction, that would result from the proposed lease sale would replace activity resulting from existing leases that have reached or are near the end of their economic life.

Like past lease sales, the proposed WPA lease sale would contribute to maintaining the present level of OCS activity in the Gulf of Mexico. Exploration and development activity, including service-vessel trips, helicopter trips, and construction, that would result from the proposed lease sale would replace activity resulting from existing leases that have reached, or are near the end of, their economic life.

Environmental Impacts

If the proposed lease sale would be canceled, the resulting development of oil and gas would most likely be postponed to a future sale; therefore, the overall level of OCS activity in the WPA would only be reduced by a small percentage, if any. Therefore, the cancellation of the lease sale would not significantly change the environmental impacts of overall OCS activity.

Economic Impacts

A sudden change in policy that restricts access to oil and gas resources or that alters the timetables the offshore industry has come to depend on when making their investment decisions may lead to undesirable socioeconomic disruptions in local coastal economies (USDOI, MMS, 2007g). Since 1983, this Agency has scheduled and held annual areawide lease sales in the Gulf of Mexico, canceling only two lease sales. In October 2006, this Agency and the State of Louisiana reached a settlement on the lawsuit filed by the State challenging WPA Lease Sale 200. As part of this settlement, this Agency canceled CPA Lease Sale 201, scheduled for March 2007. However, the acreage was offered 7 months later in CPA Lease Sale 205 (October 2007). This Agency canceled WPA Lease Sale 215 in July 2010 after the *Deepwater Horizon* event. Direct economic impacts are occurring from the cancellation of WPA Lease Sale 215; however, there are limitations to BOEMRE's awareness for what business decisions industry has made or intends to make that are the result of the cancellation of WPA Lease Sale 215, let alone the consequences of selecting Alternative C to cancel another WPA lease sale.

The cancellation of the lease sale may have economic impacts on an industry that has planned their investments according to annual lease sales in the Gulf of Mexico. Smaller independent companies would have fewer alternative projects available in their investment portfolios, and thus would be more affected by the cancellation of the sale. Therefore, they would have a more difficult time than major companies replacing lost production capacity. The magnitude and length of economic impacts on industry would be dependent on individual firm characteristics, global trends, and the number of lease sales canceled or delayed.

Canceling the lease sale would result in delaying the subsequent development activities that would take place. Revenues collected by the Federal Government (and thus revenue disbursements to the States) would be adversely affected by such a delay due to the "time value of money" (i.e., a dollar received in the future is valued less than the same dollar received today because of the opportunity to earn interest). Canceling the lease sale would delay the receipt of interest on billions of dollars of bonus bids, rental income, and royalty income by the Federal treasury.

Other Sources of Energy

Other sources of energy may substitute for the delayed or lost production. Principal substitutes would be additional imports, conservation, additional domestic production, and switching to other fuels. These alternatives, except conservation, have their own significant negative environmental and socioeconomic impacts.

Chapter 4.2.1.4 of the Multisale EIS briefly discusses the most likely alternative energy sources, the quantities expected to be needed, and the environmental and socioeconomic impacts associated with these alternative energy sources. The discussion is based on material from the following publications: *Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012* (USDOI, MMS, 2007c); *Gulf of Mexico Outer Continental Shelf Oil and Gas Leasing Program: 2007-2012, Final Environmental Impact Statement* (USDOI, MMS, 2007a); and *Energy Alternatives and the Environment* (King, 2007).

Summary and Conclusion

If Alternative C is selected, all impacts, positive and negative, associated with the WPA proposed action discussed in **Chapter 4** would be eliminated. The incremental contribution of the proposed action to cumulative effects would also be eliminated, but the effects from other activities, including other OCS lease sales, would remain.

If the lease sale would be canceled, the resulting oil and gas exploration and development activity would most likely be postponed to a future sale; therefore, the overall level of OCS activity in the WPA would only be reduced by a small percentage, if any. Therefore, the cancellation of the proposed lease sale would not significantly change the environmental impacts of overall OCS activity. The WPA Lease Sale 215 was canceled on July 28, 2010 (*Federal Register*, 2010g). The impact on oil and gas activity in the GOM of selecting Alternative C to cancel another GOM lease sale is more problematic in forecasting the combined impact on industry levels of activity resulting from two canceled WPA lease sales. Direct economic impacts have undoubtedly already occurred from the cancellation of WPA Lease Sale 215; however, there are limitations to BOEMRE's awareness for what business decisions industry has made or intends to make that are the result of the cancellation of WPA Lease Sale 215, let alone the consequences of selecting Alternative C to cancel another WPA lease sale.

As an oil province, so far the highest daily oil production rate in the GOM has been 1.73 million barrels/day (MMbbl/d) in June 2002 (The Oil Drum, 2009). On January 3, 2011, Casselman and Gilbert (2011a) reported that a slowed permitting process in the GOM has long-term implications for U.S. oil production. The DOE's Energy Information Administration reported that domestic crude oil production in the U.S. in 2010 as 5.51 MMbbl/d. The DOE's Energy Information Administration also reported that production in the GOM would decline 190,000 bbl/d in 2011 and 2012 (USDOE, Energy Information Administration, 2011b). The forecasted production declines in the GOM are partially offset by projected increases in the lower-48, non-GOM production of 220,000 bbl/d in 2011 and 70,000 bbl/d in 2012. The DOE's Energy Information Administration also reported that a drop in GOM natural gas production in 2011 and 2012 would be more than offset by increases in production in the lower 48 states (USDOE, Energy Information Administration, 2011b). The duration of the decline reported by DOE's Energy Information Administration for GOM oil production is uncertain, as is the question of whether or not GOM oil production will return to pre-DWH event levels of approximately 1.6 MMbbl/d in 2009 (USDOE, Energy Information Administration, 2010e).

Some operators have been reported to be shifting investments out of the Gulf (Casselman and Gilbert, 2011a). BP PLC recently said it would move a brand-new rig that was meant to work in the Gulf, Pride International Inc.'s *Deep Ocean Ascension*, to Libya. Marathon Oil Corp. has tried to cancel a contract for a newly built Gulf rig owned by Noble Corp. (Casselman and Gilbert, 2011a). When the moratorium was announced on July 12, 2010, by Secretary of the Interior Ken Salazar, some industry leaders predicted thousands of layoffs and a quick exodus of rigs from the Gulf. Instead, most companies either kept their rigs on stand-by or kept them busy with jobs that were not covered by the moratorium, such as decommissioning nonproducing equipment and plugging and abandoning nonproductive wells (Casselman and Gilbert, 2011a).

There are signs that companies remain committed to the Gulf. On December 16, 2010, Chevron announced 2011 commitments to further develop discoveries at Big Foot, Jack/St. Malo, Tahiti-2, Perdido, and Buckskin. Gilbert (2011) reported that deepwater operators, such as Transocean Ltd., had 12 of 13 deepwater rigs leased for work in the GOM.

On January 3, 2011, Casselman and Gilbert (2011b) reported that the Obama Administration announced an agreement to clear a path for 13 companies drilling deepwater prospects at the time of the moratorium to renew drilling 16 of their projects. The plans controlling the drilling operations must be revised to comply with new safety regulations, but new environmental reviews under NEPA in most cases would not be required.

Smaller oil companies that often work in shallower water, however, are less able to wait out a slowdown if paying high fixed costs for rigs that are idle because of longer permitting timeframes. On January 4, 2011, Gilbert (2011) reported that of the 83 shallow-water rigs in the Gulf, 29 were leased as of December 20, compared with 39 at the time of the DWH event. Among the hardest hit have been Hercules Offshore Inc. and Seahawk Drilling Inc., both of Houston, Texas. Gilbert (2011) contains a graphic showing GOM shallow-water operators and the number of rigs owned versus the number of rigs now leased. Some of these operators are going through layoffs, such as Hercules, which let go 2,000 workers over the last 18 months (Gilbert, 2011).

One condition to which operators pay close attention is uncertainty in access to new land offerings on the OCS or access to their current leases in the face of large capital costs under existing contracts that assumed work would proceed expeditiously. The outcomes of numerous Presidential and Secretarial inquiries following the DWH event are not yet totally known with respect to how recommendations could influence regulations. Since the October 14, 2010, release of the new safety regulations, industry and BOEMRE's experience for the ramp-up time needed to understand and reach compliance with them has proven to be a work in progress. Both conditions, immediate new requirements and possible future unknown requirements, have lead to uncertainty.

Alternative C, the cancellation of WPA Lease Sale 218, on top of already canceled WPA Lease Sale 215, would manifest further impacts. The magnitude would depend upon the operating plans of individual companies that currently operate or hold leases in the GOM and that also operate in other areas of the world. The last WPA sale, Lease Sale 210, was held on August 19, 2009. The end of the current 5-Year Program (2007-2012) is June 30, 2012.

Operators that have interests worldwide must balance their company resources against multiple, independent variables. Among these variables are future price forecasts, geologic basin (e.g., if it is gas prone or oil prone), quality of prospect inventory in each basin, the in-house maturation state of prospect inventories, partnering relationships with other operators or national oil companies, and in-country operator risk (e.g., if the country has a stable political environment and legal system to protect investment). The U.S. has been long regarded as a favorable operating environment because of a strong tradition for the rule of law, a stable political system, a tested leasing program with regular opportunities to secure access to land in lease sales, and a mature regulatory system for OCS operations.

Alternative C, in combination with canceled WPA Lease Sale 215, could cause a company to reevaluate operator risk in rebalancing a worldwide portfolio of operating opportunities. If a company begins to view lease sale predictability as being in question or at least counter to longstanding experience in the GOM, it may decide to shift its attention and assets to other places in the world until new and predictable processes are developed and tested. Because contracts tend to be multiyear, a commitment of drilling rigs and other support services to operate in other geologic basins could extend from 2 to 5 years.

Alternative C would also negatively affect revenues collected by the Federal Government and the revenue distributions to the States that are based on total revenue.

Other sources of energy may partially substitute for the lost production. Principal substitutes would be additional imports, conservation, additional domestic production, and switching to other fuels. Except for conservation, these alternatives have negative environmental impacts of their own, some of which are significant. For example, increased tanker traffic in U.S. territorial waters carries with it the risk for collisions and oil spills. The quantity spilled in tanker accidents or collisions could be large and take place instantaneously for the most part.

4.2. Unavoidable Adverse Impacts of the Proposed Action

Unavoidable adverse impacts associated with the proposed action are expected to be primarily short term and localized in nature and are summarized below. Adverse impacts from catastrophic events could be of longer duration and extend beyond the local area. All OCS activities involve temporary and exclusive use of relatively small areas of the OCS over the lifetimes of specific projects. Lifetimes for these activities can be days, as in the case of seismic surveys; or decades, as in the case of a production structure or platform. No activities in the OCS Program involve the permanent or temporary use or "taking" of large areas of OCS on a semicontinuous basis. Cumulatively, however, a multitude of individual projects results in a major use of OCS space.

Sensitive Coastal Habitats: If an oil spill contacts beaches or barrier islands, the removal of beach sand during cleanup activities could result in adverse impacts if the sand is not replaced, and a beach could experience several years of tarballs washing ashore over time, causing an aesthetic impact. Sand borrowing on the OCS for coastal restorations involves the taking of a quantity of sand from the OCS and depositing it onshore, essentially moving small products of the deltaic system to another location. If sand is left where it is, it would eventually be lost to the deltaic system by redeposition or burial by younger sediments; if transported onshore, it would be lost to burial and submergence caused by subsidence and sea-level rise.

If an oil spill contacts coastal wetlands, adverse impacts could be high in localized areas. In more heavily oiled areas, wetland vegetation could experience suppressed productivity for several years; in more lightly oiled areas, wetland vegetation could experience die-back for one season. Epibionts on wetland vegetation and grasses in the tidal zone could be killed, and the productivity of tidal marshes for the vertebrates and invertebrates that use them to spawn and develop could be impaired. Much of the wetland vegetation would recover over time, but some wetland areas could be converted to open water. Some unavoidable impacts could occur during pipeline and other related coastal construction, but regulations are in place to avoid and minimize these impacts to the maximum extent practicable. Unavoidable impacts resulting from dredging, wake erosion, and other secondary impacts related to channel use and maintenance would occur as a result of the proposed action.

Sensitive Coastal and Offshore Biological Habitats: Unavoidable adverse impacts would take place if an oil spill occurred and contacted sensitive coastal and offshore biological habitats, such as *Sargassum* at the surface; fish, turtles, and marine mammals in the water column; or benthic habitats on the bottom. There could be some adverse impacts on organisms contacted by oil, dispersant chemicals, or emulsions of dispersed oil droplets and dispersant chemicals that, at this time, are not completely understood, particularly in subsurface environments.

Water Quality: Unavoidable adverse impacts from routine offshore operations are dependent in large part on the quality of the water. Drilling, construction, overboard discharges of drilling mud and cuttings, and pipelaying activities would cause an increase in the turbidity of the affected waters for the duration of the activity periods. This, however, would only affect water in the immediate vicinity of the construction activity or in the vicinity of offshore structures, rigs, and platforms. The discharge of treated sewage from manned rigs and platforms would increase the levels of suspended solids, nutrients, chlorine, and biochemical oxygen demand in a small area near the discharge point for a short period of time. Accidental spills from platforms and the discharge of produced waters could result in increases of hydrocarbon levels and trace metal concentrations in the water column in the vicinity of the platforms. Spilled oil from a tanker collision would affect the water surface in combination with dispersant chemicals used during spill response. A subsurface blowout would subject the surface, water column, and near-bottom environment to spilled oil and gas released from solution, dispersant chemicals, or emulsions of dispersed oil droplets and dispersant chemicals.

Unavoidable impacts to onshore water quality would occur as a result of chronic point- and nonpoint-source discharges such as runoff and effluent discharges from existing onshore infrastructure used in support of lease sale activities. Vessel traffic contributes to the degradation of water quality by chronic low-quantity oil leakage, treated sanitary and domestic waste, bilge water, and contaminants known to exist in ship paints. Regulatory requirements of the State and Federal water authorities and some local jurisdictions would be applicable to point-source discharges from support facilities such as refineries and marine terminals.

Air Quality: Unavoidable short-term impacts on air quality could occur after large oil spills and blowouts because of evaporation and volatilization of the lighter components of crude oil, combustion from surface burning, and aerial spraying of dispersant chemicals. Mitigation of long-term effects from offshore engine combustion during routine operations would be accomplished through existing regulations and development of new control emission technology. Short-term effects from spill events are uncontrollable and are likely to be aggravated or mitigated by the time of year the spills take place.

Threatened and Endangered Species: Because this is a lease sale that does not in and of itself make any irreversible or irretrievable commitment of resources that would foreclose the development or implementation of any reasonable and prudent measures to comply with the Endangered Species Act, BOEMRE may proceed with publication of the Supplemental EIS and finalize a decision among these alternatives even if consultation is not complete, consistent with 7(d) of the ESA. Irreversible loss of individuals that are ESA-listed species may occur after a large oil spill from the acute impact of being oiled or the chronic impact of oil having eliminated, reduced, or rendered suboptimal the food species upon which they were dependent.

Nonendangered and Nonthreatened Marine Mammals: Unavoidable adverse impacts to nonendangered and nonthreatened marine mammals would be those that also affect endangered and threatened marine mammal species. Routine operation impacts (such as seismic surveys, water quality and habitat degradation, helicopter disturbance, vessel collision, and discarded trash and debris) would be negligible or minor to a population, but they could be lethal to individuals as in the case of a vessel collision. A large oil spill would temporarily degrade habitat if spilled oil, dispersant chemicals, or emulsions of dispersed oil droplets and dispersant chemicals contact free-ranging pods or spawning grounds.

Coastal and Marine Birds: Unavoidable adverse impacts from routine operations on coastal birds could result from helicopter and OCS service-vessel traffic, facility lighting, and floating trash and debris. Marine birds could be affected by noise, platform lighting, aircraft disturbances, and trash and debris associated with offshore activities. Cross-Gulf migrating species could be affected by lighted platforms, helicopter and vessel traffic, and floating trash and debris. If a large oil spill occurs and contacts coastal or marine bird habitats, some birds could experience lethal and sublethal impacts from oiling, and birds feeding or resting in the water could be oiled and die. Coastal birds coming into contact with oil may migrate more deeply into marsh habitats, out of reach from spill responders seeking to count them or collect them for rehabilitation. Oil spills and oil-spill cleanup activities could also affect the food species for coastal, marine, and migratory bird species.

Fish Resources and Commercial Fisheries: Unavoidable adverse impacts from routine operations are loss of open ocean or bottom areas desired for fishing by the presence or construction of OCS facilities and pipelines. Loss of gear could occur from bottom obstructions around platforms and subsea production systems. Routine discharges from vessels and platforms are minor given the available area for fish habitat. If a large oil spill occurs, the oil, dispersant chemicals, or emulsions of oil droplets and dispersant chemicals could temporarily displace mobile fish species on a population or local scale. It is unlikely that fishermen would want, or be permitted, to harvest fish in the area of an oil spill, as spilled oil could coat or contaminate commercial fish species rendering them unmarketable.

Recreational Beaches: Unavoidable adverse impacts from routine operations may result in the accidental loss overboard of some floatable debris that may eventually come ashore on frequented recreational beaches. A large oil spill could make landfall on recreational beaches, leading to local or regional economic losses and stigma effects, causing potential users to avoid the area after acute impacts have been removed. Some recreational beaches become temporarily soiled by weathered crude oil, and tarballs may come ashore long after stranded oil has been cleaned from shoreline areas.

Economic Activity: Net economic, political, and social benefits accrue from the production of hydrocarbon resources. Once these benefits become routine, unavoidable adverse impacts from routine operations follow trends in supply and demand based on the commodity prices for oil, gas, and refined hydrocarbon products. Declines in oil and gas prices can lead to activity ramp downs by operators until prices rise. A large oil spill would cause temporary increases in economic activity associated with spill-response activity. An increase in economic activity from the response to a large spill could be offset by temporary work stoppages that are associated with spill-cause investigations and would involve a transfer or displacement of demand to different skill sets. Routine operations affected by new regulations that are incremental would not have much affect on the baseline of economic activity; however, temporary work stoppages or the introduction of several new requirements at one time that are costly to implement could cause a drop off of activity as operators adjust to new expectations or use the opportunity to move resources to other basins where they have interests.

Archaeological Resources: Unavoidable adverse impacts from routine operations could lead to the loss of unique or significant archaeological information if unrecognized at the time an area is disturbed. Required archaeological surveys significantly reduce the potential for this loss by identifying potential archaeological sites prior to an interaction occurring, thereby making avoidance or mitigation of impacts possible. A large oil spill could make landfall on or near protected archaeological landmarks to cause temporary aesthetic or cosmetic impacts until the oil is cleaned or degrades.

4.3. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible or irretrievable commitment of resources refers to impacts or losses to resources that cannot be reversed or recovered. Examples are when a species becomes extinct or when wetlands are permanently converted to open water. In either case, the loss is permanent.

Wetlands: An irreversible or loss of wetlands and associated biological resources could occur if wetlands are permanently lost because of impacts caused by dredging and construction activities that displace existing wetlands or from oil spills severe enough to cause permanent die-back of vegetation and conversion to open water. Construction and emplacement of onshore pipelines in coastal wetlands displace coastal wetlands in disturbed areas that are then subject to indirect impacts like saltwater intrusion or erosion of the marsh soils along navigation channels and canals. Ongoing natural and anthropogenic processes in the coastal zone, only one of which is OCS-related activity, can result in direct and indirect loss of wetlands. Natural losses as a consequence of the coastal area becoming hydrologically isolated from the Mississippi River that built it, sea-level rise, and subsidence of the delta platform in absence of new sediment added to the delta plain appear to be much more dominant processes impacting coastal wetlands.

Sensitive Nearshore and Offshore Biological Resources: An irreversible loss or degradation of ecological habitat caused by cumulative activity tends to be incremental over the short term. Irretrievable loss may not occur unless or until a critical threshold is reached. It can be difficult or impossible to identify when that threshold is, or would be, reached. Oil spills and chronic low-level pollution can injure and kill organisms at virtually all trophic levels. Mortality of individual organisms can be expected to occur, and possibly a reduction or even elimination of a few small or isolated populations. The proposed biological stipulations, however, are expected to eliminate most of these risks.

Threatened and Endangered Species: Irreversible loss of individuals that are protected species may occur after a large oil spill from the acute impact of being oiled or the chronic impact of oil having eliminated, reduced, or rendered suboptimal the food species upon which they were dependent.

Fish Resources and Commercial Fisheries: Irreversible loss of fish and coral resources, including commercial and recreational species, are caused by structural removal using explosives. Fish in proximity to an underwater explosion can be killed. Without the structure to serve as habitat area, sessile, attached invertebrates and the fish that live among them is absent. Removing structures eliminates these special and local habitats and the organisms living there, including such valuable species as red snapper. Continued structure removal, regardless of the technique used, would reduce the net benefits to commercial fishing due to the presence of these structures.

Recreational Beaches: Impacts on recreational beaches from a large oil spill may at the time seem irreversible, but the impacts are temporary. Beaches fouled by a large oil spill would be temporarily unavailable to the people who would otherwise frequent them, but only during the period between landfall and cleanup of the oil, followed by an indefinite lag period during which stigma effects recede from public consciousness.

Archaeological Resources: Irreversible loss of a prehistoric or historic archaeological resource can occur if bottom-disturbing activity takes place without the required survey to demonstrate its absence before work proceeds. A resource can be completely destroyed, severely damaged, or the scientific context badly impaired by well drilling, subsea completions, and platform and pipeline installation, or sand borrowing.

Oil and Gas Development: Leasing and subsequent development and extraction of hydrocarbons as a result of the proposed action represents an irreversible and irretrievable commitment by the removal and consumption of nonrenewable oil and gas resources. The estimated amount of resources to be recovered as a result of the proposed action is presented in **Table 3-1**.

Loss of Human and Animal Life: The OCS oil and gas exploration, development, production, and transportation are carried out under comprehensive, state-of-the-art, enforced regulatory procedures designed to ensure public and work place safety and environmental protection. Nevertheless, some loss of human and animal life is inevitable from unpredictable and unexpected acts of man and nature (i.e., unavoidable accidents, accidents caused by human negligence or misinterpretation, human error, willful noncompliance, and adverse weather conditions). Some normal and required operations, such as structure removal, can kill sea life in proximity to explosive charges or by removal of the structure that served as the framework for invertebrates living on it and the fish that lived with it.

4.4. RELATIONSHIP BETWEEN THE SHORT-TERM USE OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The short-term effects on various components of the environment in the vicinity of the proposed action are related to long-term effects and the maintenance and enhancement of long-term productivity.

Short-Term Use

Short-term refers to the total duration of oil and gas exploration and production activities. Extraction and consumption of offshore oil and natural gas is a short-term benefit. Discovering and producing domestic oil and gas now delays the increase in the Nation's dependency on foreign imports. Depleting a nonrenewable resource now removes these domestic resources from being available for future use. The production of offshore oil and natural gas from the proposed action would provide short-term energy, and as it delays the increase in the Nation's dependency on foreign imports, it can also allow additional time for ramp-up and development of long-term renewable energy sources or substitutes for nonrenewable oil and gas. Economic, political, and social benefits would accrue from the availability of these natural resources.

The principle short-term use of the leased areas in the GOM would be for the production of 0.222-0.423 BBO and 1.495-2.647 Tcf of gas from the WPA proposed action. The cumulative impacts scenario in the Multisale EIS extended from 2007 to 2046, and the cumulative scenario for this Supplemental EIS extends approximately from 2012 to 2052. The 40-year time period is used because it is the approximate longest life span of activities conducted on an individual lease. The next 40 years is the period of time during which the activities and impacting-factors that follow as a consequence of the proposed lease sale would be influencing the environment.

The specific impacts of the proposed action vary in kind, intensity, and duration according to the activities occurring at any given time (**Chapter 3**). Initial activities, such as seismic surveying and exploration drilling, result in short-term, localized impacts. Development drilling and well workovers occur sporadically throughout the life of the proposed action but also result in short-term, localized impacts. Activities during the production life of a platform may result in chronic impacts over a longer period of time (over 25 years), potentially punctuated by more severe impacts as a result of accidental events or a spill. Platform removal is also a short-term activity with localized impacts, including removal of the habitat for encrusting invertebrates and fish living among them. Many of the effects on physical, biological, and socioeconomic resources discussed in **Chapter 4** are considered to be short term (being greatest during the construction, exploration, and early production phases). These impacts would be further reduced by the mitigation measures discussed in **Chapter 2**.

The OCS development off Louisiana and Texas has enhanced recreational and commercial fishing activities, which in turn has stimulated the manufacture and sale of larger private fishing vessels and specialized recreational fishing equipment. Commercial enterprises such as charter boats have become heavily dependent on offshore structures for satisfying recreational customers. The proposed action could increase these incidental benefits of offshore development. Offshore fishing and diving has gradually increased in the past three decades, with offshore structures and platforms becoming the focus of much of that activity. As mineral resources become depleted, platform removals would occur and may result in a decline in these activities.

The short-term exploitation of hydrocarbons for the OCS Program in the GOM may have long-term impacts on biologically sensitive coastal and offshore resources and areas if a large oil spill occurs. A spill and spill-response activity could temporarily interfere with commercial and recreational fishing, beach use, and tourism in the area where the spill makes landfall and in a wider area based on stigma effects. The proposed leasing may also result in onshore development and population increases that could cause very short-term adverse impacts to local community infrastructure, particularly in areas of low population and minimal existing industrial infrastructure (**Chapter 4.1.1.18**).

Relationship to Long-Term Productivity

Long-term refers to an indefinite period beyond the termination of oil and gas production. Over a period of time after peak oil production has occurred in the GOM, a gradual easing of the specific impacts caused by oil and gas exploration and production would occur as the productive reservoirs in the GOM have been discovered and produced, and have become depleted. The Oil Drum (2009) showed a graphic demonstrating that peak oil production in the GOM occurred in June 2002 at 1.73 Mbbl/d. Whether or not this date is correct can only be known in hindsight and only after a period of years while production continues. At this time, however, the trend is fairly convincing (The Oil Drum, 2009). There is disagreement on what future production trends may be in the GOM after several operators, BP among them, announced discoveries over the last 5 years (Oil and Gas Journal, 2009) in the Lower Tertiary in ultra-deepwater with large projected reserves. These claims are as yet unproven and there are questions as to the difficulties that may be encountered producing these prospects because of their geologic age, burial depth and high-temperature, high pressure in-situ conditions, lateral continuity of reservoirs, and the challenges of producing from ultra-deepwater water depths.

The GOM's large marine ecosystem is considered a Class II, moderately productive ecosystem (mean phytoplankton primary production 150-300 gChlorophyll-*a*/m^2-yr [The Encyclopedia of Earth, 2008]), based on Sea-viewing Wide Field-of-view Sensor (SeaWiFS) global primary productivity estimates (USDOC, NASA, 2003). After the completion of oil and gas production, a gradual ramp-down to economic conditions without oil and gas activity would be experienced, while the marine environment is generally expected to remain at or return to its normal long-term productivity levels that in recent years has been described as stressed (The Encyclopedia of Earth, 2008). The GOM's large marine ecosystem shows signs of ecosystem stress in bays, estuaries, and coastal regions (Birkett and Rapport, 1999). There is shoreline alteration, pollutant discharge, oil and gas development, and nutrient loading. The overall condition for the U.S. section of this large marine ecosystem, according to USEPA's seven primary indicators (Jackson et al., 2000), is good dissolved oxygen, fair water quality, poor coastal wetlands, poor eutrophic condition, and poor sediment, benthos, and fish tissue (The Encyclopedia of Earth, 2008).

To help sustain the long-term productivity of the GOM ecosystem, the OCS Program provides structures to use as site-specific artificial reefs and fish-attracting devices for the benefit of commercial and recreational fishermen and to sport divers and spear fishers. Additionally, the OCS Program continues to improve the knowledge and mitigation practices used in offshore development. Approximately 10 percent of the oil and gas structures removed from the OCS are eventually used for State artificial reef programs.